GPIB-SCSI-A
User Manual

SCSI-to-IEEE 488 Controller

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FCC/DOC Radio Frequency Interference Compliance

This equipment generates and uses radio frequency energy and, if not installed and used in strict accordance with the instructions in this manual, may cause interference to radio and television reception. This equipment has been tested and found to comply with the following two regulatory agencies:

Federal Communications Commission

This device complies with Part 15 of the Federal Communications Commission (FCC) Rules for a Class A digital device. Operation is subject to the following two conditions:

1. This device may not cause harmful interference in commercial environments.

2. This device must accept any interference received, including interference that may cause undesired operation.

Canadian Department of Communications

This device complies with the limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications (DOC).

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de classe A prescrites dans le règlement sur le brouillage radioélectrique édicté par le ministère des communications du Canada.

Instructions to Users

These regulations are designed to provide reasonable protection against harmful interference from the equipment to radio reception in commercial areas. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

There is no guarantee that interference will not occur in a particular installation. However, the chances of interference are much less if the equipment is installed and used according to this instruction manual.

If the equipment does cause interference to radio or television reception, which can be determined by turning the equipment on and off, one or more of the following suggestions may reduce or eliminate the problem.

- Operate the equipment and the receiver on different branches of your AC electrical system.
- Move the equipment away from the receiver with which it is interfering.
- Reorient or relocate the receiver's antenna.
- Be sure that the equipment is plugged into a grounded outlet and that the grounding has not been defeated with a cheater plug.

Notice to user: Changes or modifications not expressly approved by National Instruments could void the user's authority to operate the equipment under the FCC Rules.

If necessary, consult National Instruments or an experienced radio/television technician for additional suggestions. The following booklet prepared by the FCC may also be helpful: *How to Identify and Resolve Radio-TV Interference Problems.* This booklet is available from the U.S. Government Printing Office, Washington, DC 20402, Stock Number 004-000-00345-4.

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About This Manual

This manual describes the function of the GPIB-SCSI-A and contains information concerning its operation and programming.

The GPIB-SCSI-A is one of the National Instruments family of IEEE 488 support products. These products are small, high-performance, converters, and controllers packaged in all-metal cases.

Organization of This Manual

This manual is organized as follows:

- Chapter 1, *Description of the GPIB-SCSI-A*, contains general information about the National Instruments GPIB-SCSI-A, the IEEE 488 port, and the SCSI port. This chapter also lists all the components and accessories as well as electrical, environmental, and physical specifications of the GPIB-SCSI-A, and explains the two modes of operation for the GPIB-SCSI-A.

- Chapter 2, *Installation and Configuration of the GPIB-SCSI-A*, contains the steps for installing and configuring the GPIB-SCSI-A in S mode and G mode.

- Chapter 3, *Technical Information*, contains detailed information for advanced users who want to increase the power of the GPIB-SCSI-A.

- Chapter 4, *Programming in S Mode*, explains how to program the GPIB-SCSI-A when operating in S mode. In this mode, the GPIB-SCSI-A can be programmed from any operating system and language that has access to a SCSI port. This chapter describes programming messages, their format, and how they are processed, along with the functions and function arguments that make up the programming messages.

- Chapter 5, *S Mode Functions*, contains a detailed description of each S mode function. These functions are in alphabetical order for easy reference.

- Chapter 6, *Programming in G Mode*, explains how to program the GPIB-SCSI-A when operating in G mode. It describes programming messages, their format, and how they are processed, along with the functions and function arguments that make up the programming messages. This chapter also explains how to communicate with your SCSI device(s) through the GPIB-SCSI-A.

- Chapter 7, *G Mode Functions*, contains a detailed description of each G mode function. The functions are in alphabetical order for easy reference and each function contains its syntax and purpose, as well as some examples.

- Appendix A, *Multiline Interface Messages*, contains an interface message reference list, which describes the mnemonics and messages that correspond to the interface functions.

- Appendix B, *Status and Message Information*, describes the status and error information that the GPIB-SCSI-A records as it executes each programming message. Also described are the SCSI message bytes that the GPIB-SCSI-A responds to or generates while operating, as well as the Extended Sense keys that the GPIB-SCSI-A uses.

- Appendix C, *Operation of the GPIB*, describes the operation of the GPIB.

- Appendix D, *Operation of the SCSI*, describes the operation of the SCSI.

- Appendix E, *Parallel Polling*, explains the use and operation of parallel polls.

- Appendix F, *Customer Communication*, contains forms you can use to request help from National Instruments or to comment on our products and manuals.

- The *Glossary* contains an alphabetical list and description of terms used in this manual including abbreviations, acronyms, metric prefixes, mnemonics, and symbols.

- The *Index* contains an alphabetical list of key terms and topics used in this manual, including the page where each can be found.

Conventions Used in This Manual

The following conventions are used in this manual:

italic	Italic text denotes emphasis, a cross reference, or an introduction to a key concept.
`monospace`	Lowercase text in this font denotes text or characters that are to be literally input from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, functions, variables, filenames, and extensions, and for statements and comments taken from program code.
IEEE 488 and IEEE 488.2	IEEE 488 and IEEE 488.2 are used throughout this manual to refer to the ANSI/IEEE Standard 488.1-1987 and the ANSI/IEEE Standard 488.2-1987, respectively, which define the GPIB.

Related Documentation

The following documents contain information that you may find helpful as you read this manual:

- ANSI X3.131-1986, *small computer system interface (SCSI)*.
- ANSI/IEEE Standard 488.1-1987, *IEEE Standard Digital Interface for Programmable Instrumentation*.
- ANSI/IEEE Standard 488.2-1987, *IEEE Standard Codes, Formats, Protocols, and Common Commands*

Customer Communication

National Instruments wants to receive your comments on our products and manuals. We are interested in the applications you develop with our products, and we want to help if you have problems with them. To make it easy for you to contact us, this manual contains comment and configuration forms for you to complete. These forms are in Appendix F, *Customer Communication*, at the end of this manual.

Chapter 1
Description of the GPIB-SCSI-A

This chapter contains general information about the National Instruments GPIB-SCSI-A, the IEEE 488 port, and the SCSI port. This chapter also lists all the components and accessories as well as electrical, environmental, and physical specifications of the GPIB-SCSI-A, and explains the two modes of operation for the GPIB-SCSI-A.

The GPIB-SCSI-A is a high-performance interface product between the Small Computer Systems Interface (SCSI) and the General Purpose Interface Bus (GPIB).

Figure 1-1 shows the GPIB-SCSI-A.

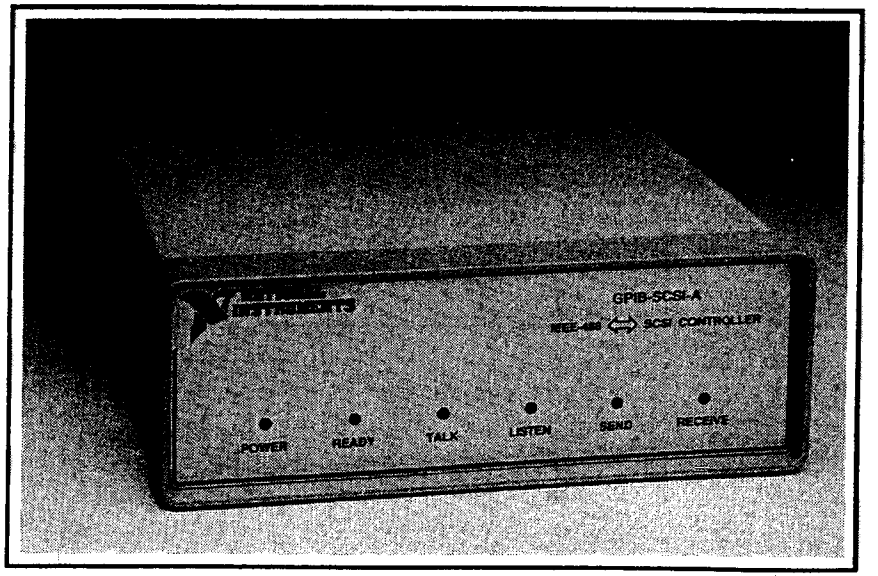

Figure 1-1. GPIB-SCSI-A

The GPIB-SCSI-A is an 8-bit microcomputer that operates as a full-function IEEE 488/SCSI Controller. The GPIB-SCSI-A can turn any computer with a SCSI port into a GPIB Talker/Listener/Controller or can make any device on the SCSI bus look like a GPIB device.

The GPIB-SCSI-A has all the software and logic required to implement the physical and electrical specifications of the IEEE 488.2 and the ANSI X3T9.2 standards. It is able to interpret and execute commands that you send to it over the GPIB or SCSI ports and perform all necessary GPIB-to-SCSI protocol conversion.

What You Need to Get Started

- ❑ One of the following boxes:
  - GPIB-SCSI-A, 100 to 120 VAC
  - GPIB-SCSI-A, 220 to 240 VAC
- ❑ One of the following power cords:
  - U.S.A. standard power cord
  - Switzerland power cord
  - Australian power cord
  - Universal European power cord
  - North American power cord
  - U.K. power cord
- ❑ Standard 50-pin SCSI-1 terminator

Optional Equipment

You can call National Instruments to order the following optional equipment.

- Rack-mount kit
  - Single (one unit)
  - Dual (two units)

- Type SCSI-A cable
  - 25-pin D-Sub to SCSI-1 (50-pin Champ)
  - —1 m, 2 m, 3 m, 4 m, or 5 m lengths

- Type SCSI-G cable
  - SCSI-1 (50-pin) to SCSI-2 (50-pin)
  - —1 m or 2 m

- Type SCSI-H cable
  - SCSI-1 (50-pin) to DEC VAXstation (68-pin)
  - —1 m or 2 m

- Type SCSI-J cable
  - SCSI-1 (50-pin Champ) to SCSI-1 (50-pin Champ)
  - —1 m or 2 m lengths

- Type SCSI-L cable
  - SCSI-1 (50-pin) to Sun-3/60 workstation port (68-pin D-shell)
  - —1 m or 2 m

- Type SCSI-M cable
  - SCSI-1 (50-pin) to Macintosh Powerbook port
  - —0.5 m

- Shielded GPIB cables*
  - GPIB Type X1 cables—1 m, 2 m, 4 m, or 8 m
  - GPIB Type X2 cables—1 m, 2 m, 4 m, or 8 m

* To meet FCC emission limits for a Class A device, you must use a shielded (Type X1 or X2) GPIB cable. Operating this equipment with a non-shielded GPIB cable may cause interference to radio and television reception in commercial areas.

Inspection

Before you install the GPIB-SCSI-A, inspect the shipping container and its contents for damage. Retain the packaging material for possible inspection or for reshipment.

If the equipment appears to be damaged, do not attempt to operate it. Contact National Instruments for instructions. If the damage appears to have been caused in shipment, file a claim with the carrier.

GPIB-SCSI-A Specifications

The following tables specify the electrical, environmental, and physical characteristics of the GPIB-SCSI-A as well as the maximum transfer rates for the GPIB-SCSI-A.

Table 1-1. Electrical Characteristics

Characteristic	Specification
Power Supply Unit	100 to 120 VAC ± 10%, 50 to 60 Hz, or 220 to 240 VAC ± 10%, 50 to 60 Hz
Current Requirement	100 to 120 VAC, 90 mA 220 to 240 VAC, 45 mA
Fuse Rating and Type	100 to 120 VAC, 200 mA UL/CSA approved 220 to 240 VAC, 125 mA IEC approved

Table 1-2. Environmental Characteristics

Characteristic	**Specification**
Operating Temperature	0° to 40° C
Storage Temperature	-20° to 70° C
Relative Humidity	10% to 90% noncondensing conditions
EMI	FCC Class A Verified

Table 1-3. Physical Characteristics

Characteristic	**Specification**
Overall Case Size	2.934 in. by 7.489 in. by 9.88 in. (74.5 mm by 190.2 mm by 250.9 mm)
Case Material	All metal enclosure
Rack Mounting	Single or dual kits available
Weight	4 lb (1.81 kg)

Table 1-4. Maximum Transfer Rates

Transfer Type	Transfer Rate
Buffered Transfer Rates:	
SCSI Reads to Buffer Memory	1 Mbytes/sec
SCSI Writes from Buffer Memory	800 kbytes/sec
GPIB Reads to Buffer Memory	980 kbytes/sec
GPIB Writes from Buffer Memory	615 kbytes/sec
Straight-Through Transfer Rates:	
GPIB Read/SCSI Write	800 kbytes/sec
GPIB Write/SCSI Read	615 kbytes/sec
Note: These numbers are the maximum rates that the hardware can send/receive data. Software overhead will affect the actual throughput of your system.	

The GPIB-SCSI-A Front Panel

The front panel of the GPIB-SCSI-A is shown in Figure 1-1. Six status Light Emitting Diodes (LEDs) are mounted on the GPIB-SCSI-A front panel.

The LEDs show the current status of the GPIB-SCSI-A at all times. Table 1-5 describes each LED.

Table 1-5. LED Descriptions

LED	Indication
POWER	Indicates that power to the unit has been applied and the ON/OFF switch is in the ON position.
READY	Indicates that the power-on self-test has passed successfully and the unit is ready to operate.
TALK	Indicates that the GPIB-SCSI-A is configured as a GPIB Talker.
LISTEN	Indicates that the GPIB-SCSI-A is configured as a GPIB Listener.
SEND	Indicates that the GPIB-SCSI-A is sending data across the SCSI.
RECEIVE	Indicates that the GPIB-SCSI-A is receiving data from the SCSI.

The GPIB-SCSI-A Rear Panel

The rear panel of the GPIB-SCSI-A is shown in Figure 1-2.

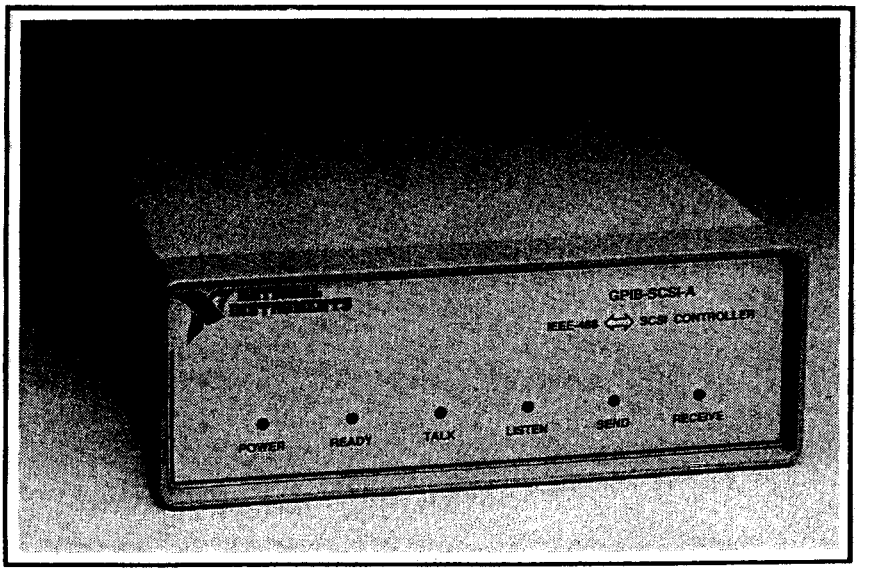

Figure 1-2. The GPIB-SCSI-A Rear Panel

The SCSI Port

The SCSI port on the GPIB-SCSI-A uses a standard SCSI-1 50 pin shielded female connector with locking clamps. A diagram of the SCSI connector and the signals supported is shown in Figure 1-3 (a * suffix indicates that the signal is active low). For a description of each of the signal lines, refer to Appendix D, *Operation of the SCSI.*

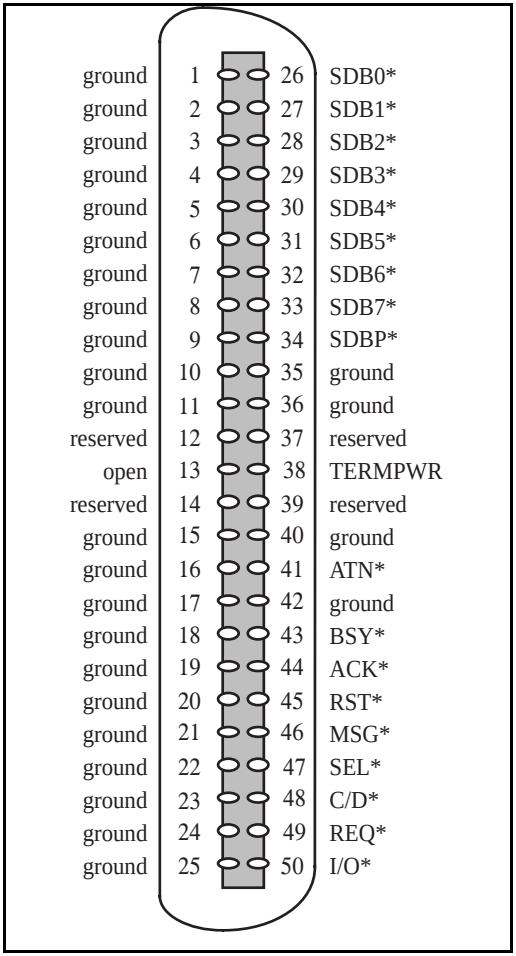
ground 1 26 SDB0*
ground 2 27 SDB1*
ground 3 28 SDB2*
ground 4 29 SDB3*
ground 5 30 SDB4*
ground 6 31 SDB5*
ground 7 32 SDB6*
ground 8 33 SDB7*
ground 9 34 SDBP*
ground 10 35 ground
ground 11 36 ground
reserved 12 37 reserved
open 13 38 TERMPWR
reserved 14 39 reserved
ground 15 40 ground
ground 16 41 ATN*
ground 17 42 ground
ground 18 43 BSY*
ground 19 44 ACK*
ground 20 45 RST*
ground 21 46 MSG*
ground 22 47 SEL*
ground 23 48 C/D*
ground 24 49 REQ*
ground 25 50 I/O*

Figure 1-3. The SCSI Connector and Signal Designations

The GPIB Port

The GPIB connector is a standard 24-pin shielded AMP Champ female connector with metric screwlock hardware. A diagram of the GPIB connector and the signals supported is shown in Figure 1-4 (a * suffix indicates that the signal is active low). For a description of each of the signal lines, refer to Appendix C, *Operation of the GPIB.*

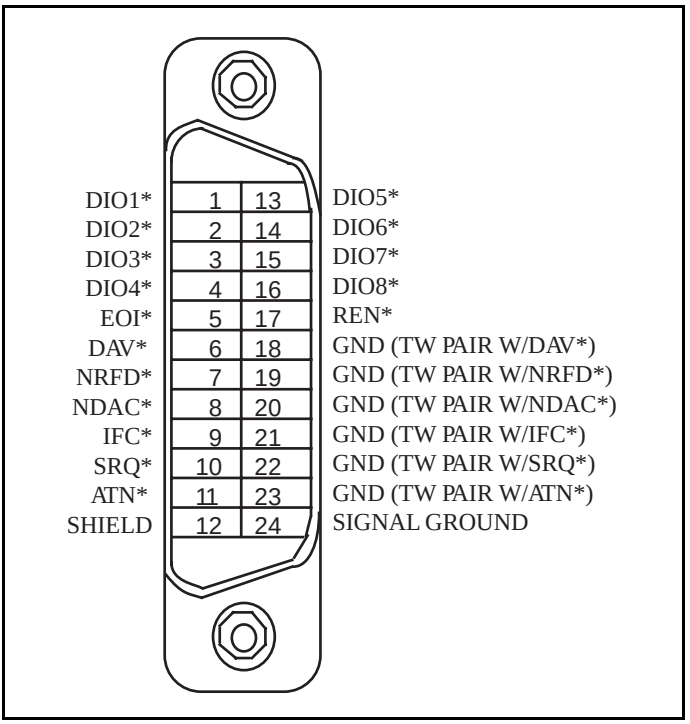
DIO1* 1 13 DIO5*
DIO2* 2 14 DIO6*
DIO3* 3 15 DIO7*
DIO4* 4 16 DIO8*
EOI* 5 17 REN*
DAV* 6 18 GND (TW PAIR W/DAV*)
NRFD* 7 19 GND (TW PAIR W/NRFD*)
NDAC* 8 20 GND (TW PAIR W/NDAC*)
IFC* 9 21 GND (TW PAIR W/IFC*)
SRQ* 10 22 GND (TW PAIR W/SRQ*)
ATN* 11 23 GND (TW PAIR W/ATN*)
SHIELD 12 24 SIGNAL GROUND

Figure 1-4. The GPIB Connector and Signal Assignments

Choosing Between S Mode and G Mode

The GPIB-SCSI-A can operate in one of two modes: *SCSI (S) mode* or *GPIB (G) mode*.

You will be connecting the GPIB-SCSI-A to both a SCSI device or system and a GPIB device or system. The mode of operation is determined from the method by which the GPIB-SCSI-A receives its programming instructions.

If you are using the GPIB-SCSI-A to communicate with and/or control GPIB devices from a SCSI host, the GPIB-SCSI-A receives its programming instructions from the SCSI host and is configured as a SCSI device. Therefore, set the GPIB-SCSI-A to operate in S mode**.**

If, on the other hand, you are using the GPIB-SCSI-A to communicate with SCSI devices from a GPIB host, the GPIB-SCSI-A receives its programming instructions from the GPIB host and is configured as a GPIB device. Therefore, set the GPIB-SCSI-A to operate in G mode.

Figure 1-5 shows the GPIB-SCSI-A operating in S mode where a personal computer with a SCSI port is controlling a GPIB system.

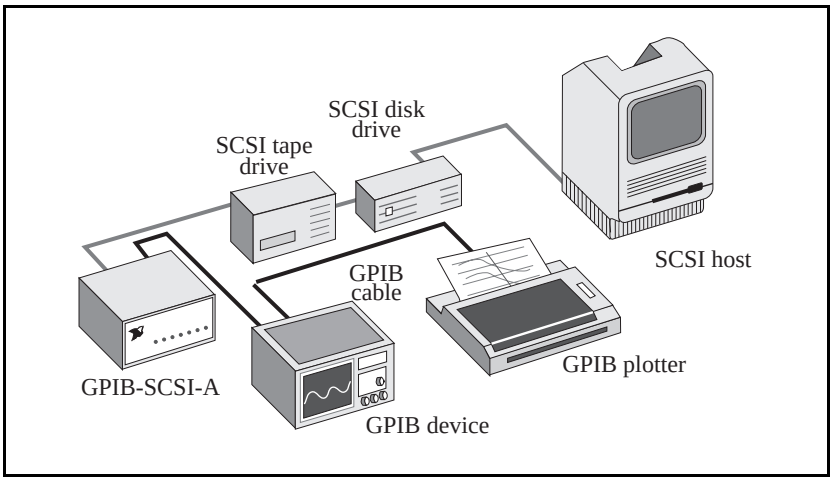

Figure 1-5. SCSI Computer Controlling GPIB Devices

Figure 1-6 shows the GPIB-SCSI-A operating in the G mode where the GPIB-SCSI-A enables SCSI devices to be accessed by a GPIB Controller.

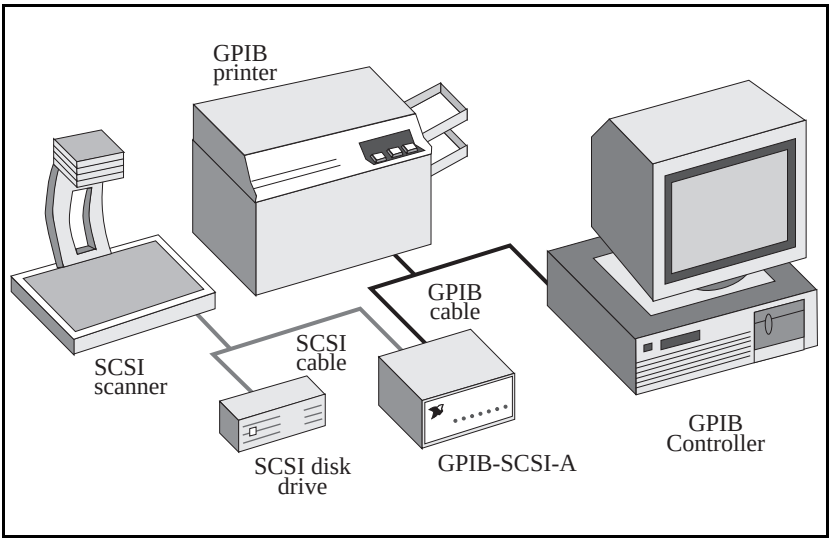

Figure 1-6. A SCSI Bus Connected to a GPIB Controller

Chapter 2
Installation and Configuration of the GPIB-SCSI-A

This chapter contains the steps for installing and configuring the GPIB-SCSI-A in S mode and G mode.

Use this chapter to configure your GPIB-SCSI-A for operation.

Installation

There are four basic steps to installing the GPIB-SCSI-A.

1. Verify the voltage requirement.
2. Configure the operating characteristics.
3. Connect the cables.
4. Switch on your GPIB-SCSI-A and power on your system.

These steps are described in more detail in the following sections.

Step 1. Verify the Voltage Requirement

The GPIB-SCSI-A is shipped from the factory with a 100 to 120 VAC or 220 to 240 VAC power supply. Verify that the voltage specified on the label on the bottom of the GPIB-SCSI-A matches the voltage that is supplied in your area.

Caution: Operating the GPIB-SCSI-A at any voltage other than the one specified could damage the unit. Replacement fuses should be the proper type and rating. Refer to Chapter 1, the section entitled *GPIB-SCSI-A Specifications*, for fuse information.

Step 2. Configure the Operating Characteristics

The GPIB-SCSI-A is shipped from the factory configured to operate in S mode. Optional parity checking on the SCSI port is disabled. The SCSI ID that the GPIB-SCSI-A responds to is set at 5, and the primary GPIB address is set at 0. Additionally, the GPIB-SCSI-A is shipped from the factory with a SCSI terminating resistor pack installed. Depending on your system, you may want to remove it.

Configuration Switch Settings for SW1

The DIP switch at location SW1 on the rear panel is used to configure the power-on primary GPIB address and SCSI ID of the GPIB-SCSI-A. The DIP switch has eight configuration switches.

The factory default setting is shown in Figure 2-1. In this figure, the black side of the switch is the side of the switch you press down.

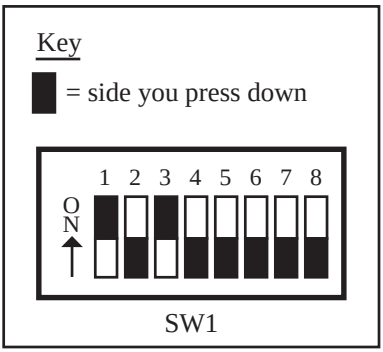

Figure 2-1. SW1 Default Mode Switch Settings

Figure 2-1 shows the factory default setting of the GPIB-SCSI-A for switch SW1. Switches 1 through 3 are ON, OFF, ON, respectively, to indicate that the SCSI ID of the GPIB-SCSI-A is 5. Switches 4 through 8 are OFF to indicate that the primary GPIB address of the GPIB-SCSI-A is 0.

Tables 2-1 and 2-2 show the possible configurations of the eight switches and what each configuration indicates.

Note: The factory default settings are in bold italic.

Table 2-1. Configuration Parameters for Switches 1 through 3

Switches 1	2	3	Indication
OFF	OFF	OFF	SCSI ID of 0
OFF	OFF	ON	SCSI ID of 1
OFF	ON	OFF	SCSI ID of 2
OFF	ON	ON	SCSI ID of 3
ON	OFF	OFF	SCSI ID of 4
ON	***OFF***	***ON***	***SCSI ID of 5***
ON	ON	OFF	SCSI ID of 6
ON	ON	ON	SCSI ID of 7

Table 2-2. Configuration Parameters for Switches 4 through 8

Switches 1	2	3			Indication
OFF	***OFF***	***OFF***	***OFF***	***OFF***	***GPIB Primary address 0***
OFF	OFF	OFF	OFF	ON	GPIB Primary address 1
OFF	OFF	OFF	ON	OFF	GPIB Primary address 2
OFF	OFF	OFF	ON	ON	GPIB Primary address 3
OFF	OFF	ON	OFF	OFF	GPIB Primary address 4
OFF	OFF	ON	OFF	ON	GPIB Primary address 5
OFF	OFF	ON	ON	OFF	GPIB Primary address 6
OFF	OFF	ON	ON	ON	GPIB Primary address 7
OFF	ON	OFF	OFF	OFF	GPIB Primary address 8
OFF	ON	OFF	OFF	ON	GPIB Primary address 9
OFF	ON	OFF	ON	OFF	GPIB Primary address 10
OFF	ON	OFF	ON	ON	GPIB Primary address 11
OFF	ON	ON	OFF	OFF	GPIB Primary address 12
OFF	ON	ON	OFF	ON	GPIB Primary address 13
OFF	ON	ON	ON	OFF	GPIB Primary address 14
OFF	ON	ON	ON	ON	GPIB Primary address 15
ON	OFF	OFF	OFF	OFF	GPIB Primary address 16
ON	OFF	OFF	OFF	ON	GPIB Primary address 17
ON	OFF	OFF	ON	OFF	GPIB Primary address 18
ON	OFF	OFF	ON	ON	GPIB Primary address 19
ON	OFF	ON	OFF	OFF	GPIB Primary address 20
ON	OFF	ON	OFF	ON	GPIB Primary address 21
ON	OFF	ON	ON	OFF	GPIB Primary address 22
ON	OFF	ON	ON	ON	GPIB Primary address 23
ON	ON	OFF	OFF	OFF	GPIB Primary address 24
ON	ON	OFF	OFF	ON	GPIB Primary address 25
ON	ON	OFF	ON	OFF	GPIB Primary address 26
ON	ON	OFF	ON	ON	GPIB Primary address 27
ON	ON	ON	OFF	OFF	GPIB Primary address 28
ON	ON	ON	OFF	ON	GPIB Primary address 29
ON	ON	ON	ON	OFF	GPIB Primary address 30
ON	ON	ON	ON	ON	GPIB Primary address 0

Configuration Switch Settings for SW2 in S Mode

The DIP switch at location SW2 on the rear panel is used to configure the mode of operation for the GPIB-SCSI-A. The DIP switch has eight configuration switches.

Figure 2-2 shows the factory default switch settings for SW2.

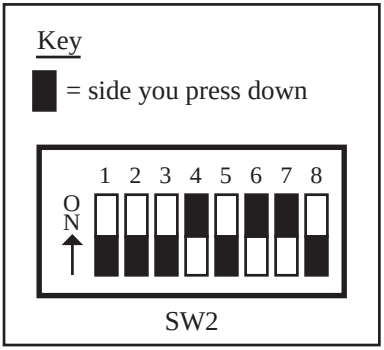

Figure 2-2. SW2 Default Switch Settings

Switch 8 is OFF, indicating that the GPIB-SCSI-A will be operating in S mode. Switch 7 is ON, indicating that the GPIB-SCSI-A will neither notice nor report SCSI parity errors. Switch 6 is ON, indicating that the GPIB-SCSI-A will buffer data during data transfer commands. Switch 5 is OFF, indicating that the GPIB-SCSI-A will complete all data requests to the exact count specified. Switches 4 is ON, indicating that double buffering will be used. Switches 1 through 3 are OFF because they are reserved.

Table 2-3 shows the possible configurations of the eight switches in S mode and what each configuration indicates.

Table 2-3. Possible Configurations for SW2 in S Mode

Switch	Position	Indication
8	OFF	S mode
7	OFF	SCSI parity generation/checking enabled
	ON	SCSI parity generation/checking disabled
6	OFF	Buffering disabled
	ON	Buffering enabled
5	OFF	Complete SCSI data phases
	ON	Do not complete SCSI data phases
4	OFF	If buffering is enabled, use single buffering
	ON	If buffering is enabled, use double buffering
1 - 3	OFF	Reserved and should remain OFF

Configuration Switch Settings for SW2 in G Mode

The setting of the DIP switch at location SW2 on the rear panel can be changed to configure the GPIB-SCSI-A for G mode. A sample setting for G mode is shown in Figure 2-3.

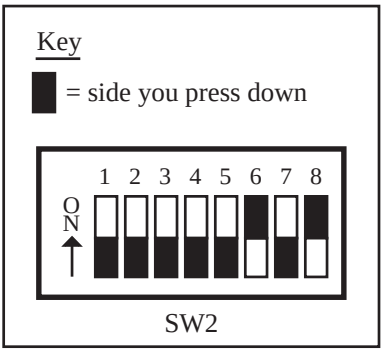

Figure 2-3. SW2 Sample Setting for G Mode

Switch 8 is ON, indicating that the GPIB-SCSI-A will be operating in G mode. Switch 7 is OFF, indicating that the GPIB-SCSI-A detects and reports SCSI parity errors. Switch 6 is ON, indicating that the GPIB-SCSI-A asserts the SCSI RST* signal at power on to reset the entire SCSI bus attached to the GPIB-SCSI-A. Switch 5 is OFF, indicating that the GPIB-SCSI-A responds to Major/Minor GPIB device addressing. Switch 4 is OFF indicating that the GPIB-SCSI-A will not assert EOI on the serial poll response byte. Switches 1 through 3 are OFF as they are reserved.

Table 2-4 shows the possible configurations of the eight switches in G mode and what each configuration indicates.

Table 2-4. Possible Configurations for SW2 in G Mode

Switch	Position	Indication
8	ON	G mode
7	OFF	SCSI parity generation/checking enabled
	ON	SCSI parity generation/checking disabled
6	OFF	Do not assert the SCSI RST* signal at power on
	ON	Assert the SCSI RST* signal at power on
5	OFF	Major/minor GPIB addressing used
	ON	Secondary addressing used
4	OFF	Do not assert EOI with serial poll response
	ON	Assert EOI with serial poll response
1 - 3	OFF	Reserved and should remain OFF

SCSI Terminating Resistors

Because of its high-speed capabilities, the SCSI bus is sensitive to the electrical characteristics of the SCSI cabling. When a signal is sent through the SCSI bus, it bounces back and creates echoes along the cabling. Devices in the middle of the daisy-chained SCSI bus receive these signal echoes.

To prevent these echoes from being generated, you can place a terminating resistor pack at each end of the daisy-chained SCSI bus to absorb the signals and eliminate potential echoes. Because SCSI signals are not reliably passed along the SCSI bus after reaching a device with a terminator, remove the terminating resistor pack on all devices except for the two at the ends of the daisy-chain.

Note: A daisy-chained system has multiple devices connected to the host.

Figure 2-4 shows the GPIB-SCSI-A located at the end of the system.

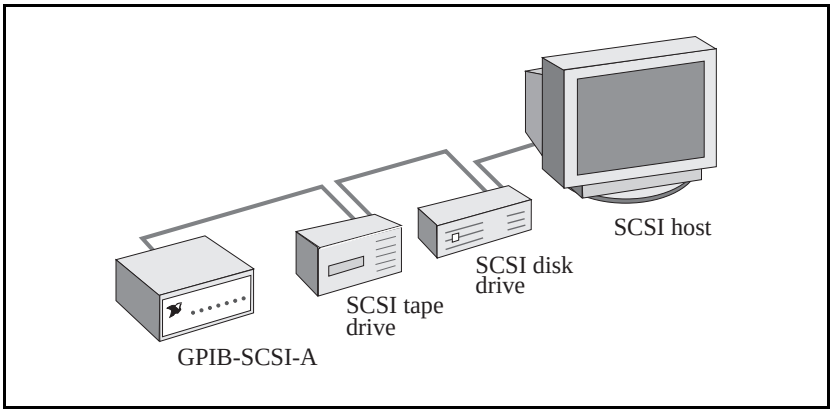

Figure 2-4. GPIB-SCSI-A Physically Located at End of SCSI Bus

If this is similar to your application, ensure that all devices between the two ends (for example, the two ends being the SCSI host and the GPIB-SCSI-A as shown in Figure 2-4) do not have terminating resistors installed. Also ensure that the GPIB-SCSI-A has the terminating resistor pack in place on one of the SCSI ports on the rear panel of the GPIB-SCSI-A.

Note: Never connect more than two sets of terminating resistors on a SCSI bus as more than two sets may overload the signals and generate errors.

Figure 2-5 shows a system in which the GPIB-SCSI-A is not at the end of the system.

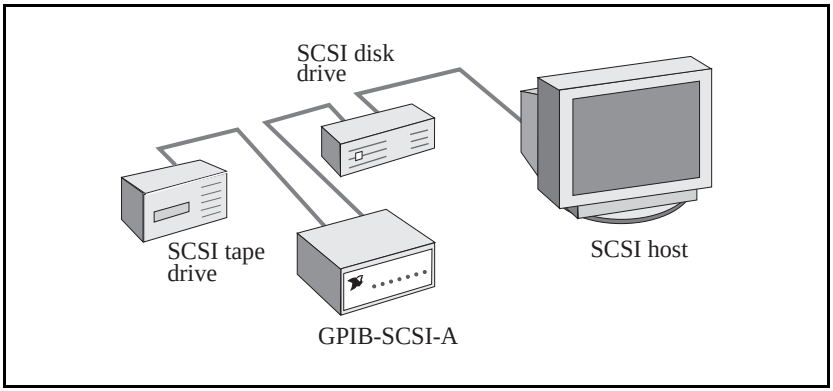

Figure 2-5. GPIB-SCSI-A Not Physically Located at End of SCSI Bus

If this is similar to your application, ensure that all devices between the two ends (for example, the two ends being the SCSI host and the SCSI tape drive as shown in Figure 2-5) do not have terminating resistors installed. Also remove the terminating resistor pack from the SCSI port on the rear panel of the GPIB-SCSI-A.

Proper termination is absolutely essential to the devices connected on a SCSI bus. Read the documentation for each device to find out what kind of termination it provides.

Step 3. Connect the Cables

Caution: Never connect or disconnect SCSI cables when *any* device (computer, tape drive, GPIB-SCSI-A, and so on) is powered on. Doing so can cause fuses to blow inside the GPIB-SCSI-A and inside other SCSI devices which supply termination power (TERMPWR) to the SCSI bus.

Complete the following steps to connect the cables:

1. Connect the SCSI cable to the GPIB-SCSI-A and securely fasten it. Connect the other end to your SCSI system. Be sure to use only shielded SCSI cables and obey all ANSI X3T9.2 cabling restrictions.

2. Connect the GPIB cable to the GPIB-SCSI-A and tighten the thumb screws on the connector. Connect the other end to your GPIB system. Be sure to obey all IEEE 488 cabling restrictions, and use only double-shielded GPIB cables.

3. Plug in the power cord into an AC outlet of the correct voltage.

Step 4. Switch On Your GPIB-SCSI-A and Power on Your System

Power on your GPIB-SCSI-A by using the rocker switch on the rear panel. The POWER LED should come on immediately and the READY indicator on the front panel should come on after the GPIB-SCSI-A has passed its power-on self-test, indicating the unit is ready for operation.

If the READY indicator does not come on within 10 sec after the unit is powered on, recheck all connections and switch settings and retry the power-on sequence. If the READY light still fails to come on, contact National Instruments.

If you have configured the GPIB-SCSI-A for S mode, refer to Chapter 4, *Programming in S Mode*, for programming information and Chapter 5, *S Mode Functions*, for S mode function information.

If you have configured the GPIB-SCSI-A for G mode, refer to Chapter 6, *Programming in G Mode*, for programming information and Chapter 7, *G Mode Functions*, for G mode function information.

Chapter 3
Technical Information

This chapter contains detailed information for advanced users who want to increase the power of the GPIB-SCSI-A.

The GPIB-SCSI-A is actually a powerful 8-bit microcomputer tailored for use as an IEEE 488-to-SCSI protocol controller. The operating system of the unit is contained in Read-Only Memory (ROM) and 256 kilobytes of Dynamic Random-Access Memory (DRAM). The GPIB-SCSI-A microprocessor operates at 10 MHz and contains an integrated Direct Memory Access (DMA) controller for high-speed data transfers from the GPIB and SCSI circuitry. The processor also contains an integrated memory management unit, a DRAM refresh controller, a clock generator, a programmable timer unit, and an interrupt controller.

All GPIB functionality is provided by a NAT4882 application-specific integrated circuit (ASIC) GPIB Controller chip, which is programmed and maintained by the operating system. All SCSI functionality is provided by an LSI SCSI controller chip, which is also programmed and maintained by the operating system. Both the GPIB and SCSI ports use interrupt conditions to process important events on either bus. The remainder of this chapter contains additional technical information for each mode of operation.

Note: Unless stated otherwise, all numbers presented in this chapter are in decimal notation.

Assumption of Previous Knowledge

This chapter assumes that you have a basic knowledge of the SCSI bus. If you are a first-time user or you would like to review the basics, refer to Appendix D, *Operation of the SCSI*, for a history of and a basic introduction to the SCSI.

Buffering Methods

In both S mode and G mode, the GPIB-SCSI-A supports three different methods of buffering data transferred between the GPIB and SCSI ports. In S mode, the buffering method can be chosen using switches 4 and 6 of SW2, or by using the `config` command. In G mode, the GPIB-SCSI-A powers up using the straight-through method, but this can be changed by using the `config` command.

When using the straight-through method, the GPIB-SCSI-A does not use the DRAM buffer to hold data transferred between the ports. The DMA controller transfers each byte directly from one port to the other, without using the DRAM buffer.

When using the single buffering method, the GPIB-SCSI-A uses the available DRAM buffer space as a single buffer for data. During every data transfer, it first fills the buffer with data from the source port. Then, it writes this data out to the destination port. If there is more data available, it fills the buffer from the source port again, and writes it out to the destination port. This process continues until all available data has been transferred.

When using the double buffering method, the GPIB-SCSI-A splits the available DRAM buffer space into two distinct buffers. During every data transfer, it first fills the first buffer with data from the source port. Then, it simultaneously writes this data to the destination port while it fills the second buffer with data from the source port. If there is more data available, it fills the first buffer from the source port while it writes data from the second buffer to the destination port. The buffers are switched like this until all the available data has been read, after which the last buffer filled is written out to the destination port.

When the GPIB-SCSI-A powers up, the number of bytes of DRAM buffer space is 224 kilobytes. This means that if double buffering is used, each of the two buffers are 112 kilobytes in size. If a smaller size is desired, it can be changed using the `config` command.

S Mode Operation

When operating in S mode, the GPIB-SCSI-A appears as a SCSI target device on the SCSI system. In this mode, any SCSI device that can perform Initiator abilities (that is, the ability to select, command, and communicate with targets) on the SCSI can use the GPIB-SCSI-A to control a GPIB system of which the GPIB-SCSI-A is a part.

In the following paragraphs, the term *Initiator* refers to the SCSI device that performs Initiator duties. The term *Target* refers to the SCSI device that is commanded by the Initiator to perform specific activities.

Configuration Switches at SW2

This section describes the purpose of each configuration switch located at SW2 on the GPIB-SCSI-A during S mode operation.

Switch 7

Switch 7 determines whether or not the GPIB-SCSI-A notifies users of the error condition created if the SCSI data bus parity is incorrect when the GPIB-SCSI-A reads data from the SCSI. Since the parity error will only be valid on SCSI reads, this error could occur in the Selection, Command, Data Out, or Message Out phase, as all these phases read data from the SCSI.

The default setting of Switch 7 is ON, parity error detection and reporting disabled.

Switch 7 ON

If Switch 7 is ON, the GPIB-SCSI-A neither detects nor reports parity errors.

Switch 7 OFF

If Switch 7 is OFF, parity error detection and notification is enabled. Upon detection of the parity error, the GPIB-SCSI-A will complete the command as if nothing were wrong and set the status byte returned to the Initiator during the Status phase to CHECK CONDITION and the Extended Sense key to ERROR. To understand the error reporting technique employed on the GPIB-SCSI-A during S mode, see the *S Mode Error Indication* section in Chapter 4, *Programming in S Mode*.

Because the GPIB-SCSI-A does not terminate the processing of a command immediately upon detection of a parity error and the error indication is identical for each of the possible phases in which the parity error can occur, there is no way to know in which phase the error occurred. Therefore, it is recommended to issue the command again.

The parity error is very rare if you are using correct SCSI cabling. If you are receiving this error often, and you are using properly shielded SCSI cabling, recheck all SCSI connections within your system to ensure proper connection. If this does not solve the problem and you are sure everything else is performing as it should, contact National Instruments for further assistance.

Switch 6

Switch 6 determines whether or not the GPIB-SCSI-A buffers data transferred during `brd`, `bwrt`, `rd`, and `wrt` commands.

The default setting of Switch 6 is ON, buffering enabled.

Switch 6 ON

If Switch 6 is ON, the GPIB-SCSI-A buffers data transferred during the `brd`, `bwrt`, `rd`, or `wrt` commands. Switch 4 is used to determine what method of buffering will be used.

Switch 6 OFF

If Switch 6 is OFF, the GPIB-SCSI-A does not buffer data transferred during the `brd`, `bwrt`, `rd`, or `wrt` commands. The straight-through method is used to transfer data from one port to the other.

Switch 5

Switch 5 determines whether or not the GPIB-SCSI-A completes the SCSI data transfers to the specified count. That is, if a `rd` or `brd` command is issued and something occurs that would create a short count (an error, a device clear, or END detected), the GPIB-SCSI-A sends all the valid data to the SCSI Initiator followed by a number of null bytes (0) equal to the difference of the original count requested and the actual count transferred. Likewise, if a `cmd`, `wrt`, or `bwrt` command is issued and something occurs that would create a short count (an error or a device clear), the GPIB-SCSI-A stops attempting to send data to the GPIB and reads in and discards the rest of the SCSI data.

The default setting of Switch 5 is OFF, complete SCSI data transfers to the specified count.

Switch 5 ON

Setting configuration Switch 5 ON causes the GPIB-SCSI-A to immediately change into the Status phase from a data transfer phase in the event of a short count instead of completing SCSI activity to the specified length.

Switch 5 OFF

If Switch 5 is OFF, the GPIB-SCSI-A completes the SCSI Data Transfer phase to the specified length.

Switch 4

If Switch 6 is ON, Switch 4 determines which buffering method to use during `brd`, `bwrt`, `rd`, and `wrt` commands. If Switch 6 is OFF, Switch 4 has no meaning.

The default setting of Switch 4 is ON, double buffering enabled.

Switch 4 ON

If Switch 4 and Switch 6 are ON, the GPIB-SCSI-A uses the double buffering method to buffer data transferred during the `brd`, `bwrt`, `rd`, and `wrt` commands.

Switch 4 OFF

If Switch 4 is OFF and Switch 6 is ON, the GPIB-SCSI-A uses the single buffering method to buffer data transferred during the `brd`, `bwrt`, `rd`, and `wrt` commands.

Switches 1 Through 3

Switches 1 through 3 are reserved for future use and should remain in the factory default position of OFF.

G Mode Operation

When operating in G mode, the GPIB-SCSI-A appears as a GPIB device on the GPIB system. In this mode, any GPIB device attached to the GPIB system of which the GPIB-SCSI-A is a part can use the GPIB-SCSI-A to control a SCSI system attached to the GPIB-SCSI-A.

Configuration Switches at SW2

This section describes the purpose of each configuration switch located at SW2 on the GPIB-SCSI-A during G mode operation.

Switch 7

Switch 7 determines whether or not the GPIB-SCSI-A notifies users of the error condition created if the SCSI data bus parity is incorrect when the GPIB-SCSI-A reads data from the SCSI. Because the parity error is only valid on SCSI reads, this error can occur in the Reselection, Data In, or Message In phase, as all these phases read data from the SCSI.

Switch 7 ON

If Switch 7 is ON, the GPIB-SCSI-A neither detects nor reports parity errors.

Switch 7 OFF

Setting configuration Switch 7 OFF enables parity error detection and notification. Upon detection of the parity error, the GPIB-SCSI-A completes the command as if nothing were wrong to prevent the locking up of the SCSI. After the operation is complete, the GPIB-SCSI-A reports an error condition by setting the ERR bit in the 16-bit internal status word of the GPIB-SCSI-A. SCERR is set to EPAR for a parity error. To understand the error reporting technique employed on the GPIB-SCSI-A in G mode, see the *Status and Error Information* section in Chapter 6, *Programming in G Mode*.

Because the GPIB-SCSI-A does not terminate the processing of a command immediately upon detection of a parity error and the error indication is identical for each of the possible phases in which the parity error can occur, there is no way to know in which phase the error occurred. Therefore, it is recommended to issue the command again.

The parity error is very rare if you are using correct SCSI cabling. If you are receiving this error often, and you are using proper, shielded SCSI cables, recheck all SCSI connections within your system to ensure proper connection. If this does not seem to be solving the problem and you are sure everything else is performing as it should, contact National Instruments for further assistance.

Switch 6

Switch 6 determines whether or not the GPIB-SCSI-A causes an asynchronous RESET condition on the SCSI bus at power on by asserting the SCSI RST* signal.

Switch 6 ON

If Switch 6 is ON, the GPIB-SCSI-A causes a RESET condition on the SCSI bus at power on by asserting the SCSI RST* signal for approximately 100 µsec. Asserting the RST* signal for 25 µsec creates the SCSI RESET condition. The response to this condition is somewhat device-dependent, with some constraints imposed by the SCSI specification.

The main purpose for creating the RESET condition is that all SCSI signals are released within a specified time period of the RST* signal assertion. The Bus Free phase always follows this condition. By asserting the RST* signal, the GPIB-SCSI-A can be used to clear a *hung* SCSI bus.

Note: If you are attaching the GPIB-SCSI-A to a SCSI system with several Initiators currently present, take care when the GPIB-SCSI-A is powered on. If this option is enabled and there is another Initiator-Target communication occurring, the assertion of the RST* signal by the GPIB-SCSI-A will cause the other communication to fail.

Additionally, you may create a RESET condition by issuing the `rst` command via the GPIB port.

Switch 6 OFF

If Switch 6 is OFF, the GPIB-SCSI-A does not cause a RESET condition on the SCSI bus at power-on.

Switch 5

Switch 5 determines whether the GPIB-SCSI-A uses Major/Minor GPIB addressing or secondary GPIB addressing to differentiate between the Command and Status Channel and the Data Channel.

For Major/Minor GPIB addressing, the Command and Status Channel of the GPIB-SCSI-A is at the address specified by switches 4 through 8 of SW1 and the Data Channel is at the address specified plus one. If GPIB primary address 30 is selected for the Command and Status Channel , the Data Channel is at GPIB primary address 0. If switches 4 through 8 of SW1 are all ON, the Command and Status Channel is at GPIB primary address 0 and the Data Channel is at GPIB primary address 1.

With secondary GPIB addressing, the Command and Status Channel of the GPIB-SCSI-A is at the GPIB primary address specified by switches 4 through 8 of SW1 with a secondary address of 0. The Data Channel is at the GPIB primary address specified by switches 4 through 8 of SW1 with a secondary address of 1. If switches 4 through 8 of SW1 are all ON, the GPIB primary address of the GPIB-SCSI-A is 0.

Switch 5 ON

If Switch 5 is ON, the GPIB-SCSI-A uses secondary GPIB addressing.

Switch 5 OFF

If Switch 5 is OFF, the GPIB-SCSI-A uses Major/Minor GPIB addressing.

Switch 4

Switch 4 determines whether or not the GPIB-SCSI-A asserts the GPIB EOI* signal during a serial poll response.

Switch 4 ON

If Switch 4 is ON, the GPIB-SCSI-A asserts the GPIB EOI* signal during a serial poll response.

Switch 4 OFF

If Switch 4 is OFF, the GPIB-SCSI-A will not assert the GPIB EOI* signal during a serial poll response.

Switches 1 Through 3

Switches 1 through 3 are reserved for future use and should remain in the factory default position of OFF.

Chapter 4
Programming in S Mode

This chapter explains how to program the GPIB-SCSI-A when operating in S mode. In this mode, the GPIB-SCSI-A can be programmed from any operating system and language that has access to a SCSI port. This chapter describes programming messages, their format, and how they are processed, along with the functions and function arguments that make up the programming messages.

Note: This chapter presumes some basic knowledge of the SCSI operation. For basic information about the SCSI, refer to Appendix D, *Operation of the SCSI.*

Programming Messages

You program the GPIB-SCSI-A by sending it programming messages (which are SCSI Command Descriptor Blocks) by way of its SCSI port. The *Command Descriptor Blocks* and all interaction on the SCSI bus must be handled by you through SCSI system calls provided by the host system.

Programming Message Format

There is only one programming message format, the *Command Descriptor Block*. These are six consecutive bytes representing information required by the GPIB-SCSI-A for each command.

Figure 4-1 shows an example of a Command Descriptor Block.

Bit / Byte	7	6	5	4	3	2	1	0
0	Opcode							
1	Possible Parameters for Command							
2	Possible Parameters for Command							
3	Possible Parameters for Command							
4	Possible Parameters for Command							
5	Reserved (Control Byte)							

Figure 4-1. Command Descriptor Block Example

You must use the SCSI system calls of the host to get the SCSI Command Descriptor Blocks built and issued to the GPIB-SCSI-A.

Additionally, you need to process all the SCSI bus phases in the proper order. For more information on the proper order of SCSI bus phases, refer to the individual command descriptions in Chapter 5, *S Mode Functions*.

Function Names and Opcodes

The GPIB-SCSI-A uses operation codes (*opcodes*) to determine which command it must execute. In the discussion of each command in Chapter 5, *S Mode Functions*, there is an associated name for each command. These names do not have any meaning to the GPIB-SCSI-A, but it is suggested that you define constants with these names to represent the opcode for each GPIB-SCSI-A function in order to ease program reading and understanding.

GPIB Address

Each device on the GPIB has a GPIB address. The GPIB-SCSI-A's address at power on is configured with Switches 4 through 8 of Switch SW1 located on the rear panel and can be changed using the `caddr` function. Together, the GPIB Primary Address and the optional GPIB Secondary Address fields of certain Command Descriptor Blocks comprise the GPIB address of the device that you wish to communicate with. Refer to your GPIB device documentation to learn the addresses of your GPIB device. You will need to know these when you begin to program the GPIB-SCSI-A.

Status Information

The function descriptions in Chapter 5, *S Mode Functions*, explain that the GPIB-SCSI-A *records* specific status and error information. This means that it stores that information in its memory so that the status information is available to you when you request it.

The function descriptions also explain that the GPIB-SCSI-A *returns to you* certain information. This means that the GPIB-SCSI-A sends information to you over the SCSI port when requested. You then interpret this status in your application.

GPIB Read and Write Termination Method (END and EOS)

You must program the GPIB-SCSI-A to talk in order to send data messages over the GPIB, and to listen in order to receive data messages from the GPIB.

The IEEE 488 specification defines two methods that GPIB Talkers and Listeners can use to identify the last byte of data messages—END and EOS. The two methods permit a Talker to send data messages of any length without the Listener(s) knowing in advance the number of bytes in the transmission.

END message — The Talker asserts the End Or Identify (EOI*) signal while the last data byte is being transmitted. The Listener stops reading when it detects a data byte accompanied by EOI.

EOS character — The Talker sends an End Of String (EOS) character at the end of its data string. The Listener stops receiving data when it detects the EOS character. Either a 7-bit ASCII character or a full 8-bit binary byte can be used.

END and EOS can be used individually or combined. It is important that the Listener is configured to detect the end of a transmission.

The GPIB-SCSI-A always terminates GPIB read operations on the END message. By using the `eos` and `eot` functions, you can change the other GPIB read and write termination methods.

The SCSI Message System and the GPIB-SCSI-A in S Mode

The SCSI specification details how an Initiator can, at any time, notify a Target that it has a message ready for the Target by creating the ATTENTION condition with the assertion of the SCSI ATN* signal. It is the prerogative of the Target to respond to the ATTENTION condition by entering the Message Out phase. The Target does *not* have to process this ATTENTION condition. The GPIB-SCSI-A processes the ATTENTION condition, but only if the GPIB-SCSI-A is selected by the Initiator with the ATN* signal active. The GPIB-SCSI-A responds to this condition by entering the Message Out phase immediately after selection and receiving the message from the Initiator. If the Initiator ever creates the ATTENTION condition again, it will be ignored by the GPIB-SCSI-A during the remainder of the command.

For additional information on the SCSI message system, see Appendix D, *Operation of the SCSI* and Appendix B, *Status and Message Information*.

S Mode Error Indication

When operating in S mode, the error indication of the GPIB-SCSI-A takes the form specified by the SCSI specification. In the event of any error, the GPIB-SCSI-A may or may not complete the command to its fullest extent, depending on the error. Eventually, when the GPIB-SCSI-A reaches the Status phase, the status byte that is sent (if any kind of error occurred) is the CHECK CONDITION status.

At this point, the GPIB-SCSI-A also sets the Extended Sense key to further indicate the error that has occurred. To get the Sense data, you need to use the `rqsns` command to request that sense data be returned from the GPIB-SCSI-A to the Initiator. You then must analyze the returned sense data to see what type of error occurred. This is the accepted way of obtaining and analyzing any error data occurring with the SCSI. For more information on the Extended Sense keys and what each key represents, see Appendix B, *Status and Message Information*.

You can also use the GPIB-SCSI-A `stat` command to receive the internal status of the GPIB-SCSI-A. You can also use the `stat` command to configure the GPIB-SCSI-A for continuous status reporting. Continuous status reporting is helpful during program development, because status and error information is returned after every command (except for `inq` and `rqsns`).

Disconnection/Reconnection

For many operations, the GPIB-SCSI-A can disconnect itself from the SCSI bus when its SCSI port is not in use. In this way, the SCSI bus does not remain idle, and can be used by other Targets (such as disk drives). Once the GPIB-SCSI-A requires use of the SCSI bus again, it reconnects itself to the Initiator.

In order for disconnection/reconnection to be possible, the Initiator must indicate to the GPIB-SCSI-A that it supports disconnection/reconnection. This is done by selecting the GPIB-SCSI-A with ATN* active to indicate that the Initiator has a message for the GPIB-SCSI-A. The message it sends must be an IDENTIFY with bit 6 (the hex 0x40 bit) set to indicate that it can support disconnection/ reconnection.

Disconnection/Reconnection during Data Transfers

During data transfer operations (`brd`, `bwrt`, `rd`, and `wrt`), there may be times when you do not want to use the straight-through method. Doing DMA port to port in this fashion essentially ties the GPIB bus and SCSI bus together. Any delay on the GPIB will affect transfers on the entire SCSI. If buffering is enabled, the GPIB-SCSI-A can disconnect itself from the SCSI bus when no data is being transferred along its SCSI port.

When an Initiator commands the GPIB-SCSI-A to perform a buffered data transfer operation and you want disconnection/reconnection, perform the following steps:

1. Selection Phase. The Initiator must select the GPIB-SCSI-A with ATN* active to indicate that the Initiator has a message for the GPIB-SCSI-A.

2. Message Out Phase. As soon as the GPIB-SCSI-A is selected and before going into the Command phase, the GPIB-SCSI-A responds to the ATN* signal by going into the Message Out phase. The Initiator should then send the IDENTIFY message with bit 6 (the hex 0x40 bit) set to indicate that it can support disconnection/ reconnection. If this bit is not set, or the Initiator does not issue an IDENTIFY message, the GPIB-SCSI-A does not disconnect/reconnect during the transfer.

3. Command Phase. Following the Message Out phase, the GPIB-SCSI-A goes into the Command phase to receive the command.

After the GPIB-SCSI-A has completed its preparation to disconnect/ reconnect the SCSI, it transfers the data by performing steps 1 and 2 as necessary.

1. The Data Transfer is using the SCSI port

   As long as there is data to transfer along the SCSI port, the GPIB-SCSI-A remains connected on the SCSI bus. While transferring the data the GPIB-SCSI-A asserts either the Data In or the Data Out phase. The Data In phase is asserted for `brd` and `rd`. The Data Out phase is asserted for `bwrt` and `wrt`.

During `bwrt` and `wrt` operations, this step is always performed before step 2. Whether you are using single or double buffering, the first buffer must be filled from the SCSI port before you can begin the GPIB transfer.

2. The Data Transfer is not using the SCSI port

   When there is no data to transfer on the SCSI port, and the data transfer is not complete, the GPIB-SCSI-A disconnects from the SCSI so that other devices can use the SCSI. This disconnection is accomplished by the GPIB-SCSI-A entering the Message In phase and delivering the SAVE DATA POINTER and the DISCONNECT messages to the Initiator to signal its intention to disconnect from the SCSI. After this, the GPIB-SCSI-A enters the Bus Free phase by releasing all SCSI signals.

   During `brd` and `rd` operations, this step is always performed before step 1. Whether you are using single or double buffering, the first buffer must be filled from the GPIB port before you can begin the SCSI transfer.

   When the SCSI port is needed, the GPIB-SCSI-A arbitrates, gains the SCSI bus, and reselects the Initiator to reconnect. (The Reselection phase is distinguished from the Selection phase by the I/O* signal, which is active during the Reselection phase.) After successful reselection of the Initiator, the GPIB-SCSI-A enters the Message In phase and delivers an IDENTIFY (0x80) message to the Initiator before resuming the data transfer (step 1) or completing the command (step 3).

3. The Data Transfer is completed

   Once all of the needed data has been transferred, the GPIB-SCSI-A terminates the command by performing the usual Status and Message In phases.

   If the transfer completes successfully, the GPIB-SCSI-A terminates the command with a GOOD status. If, however, the command was aborted due to an error, the command is terminated with a CHECK CONDITION status. For information on how to analyze this condition, see the *S Mode Error Indication* section earlier in this chapter.

When using the single buffering method, the GPIB-SCSI-A disconnects whenever it is transferring data to or from the GPIB port. For example, if the buffer size is 224K, and you issue a 300K `bwrt`, the box completes the following steps:

Step 1 : Prepares for disconnection/reconnection and receives the command.
Step 2 : Fills the buffer with 224K bytes from the SCSI.
Step 3 : Disconnects from the SCSI, writes 224K bytes from the buffer to the GPIB port, then reconnects.
Step 4 : Fills the buffer with 76K bytes from the SCSI.
Step 5 : Disconnects from the SCSI, writes 76K bytes from the buffer to the GPIB port, then reconnects.
Step 6 : Completes the command.

When using the double buffering method, the GPIB-SCSI-A disconnects whenever it can no longer transfer data to or from the SCSI port. For example, if the buffer size is 224K, and you issue a 200K `brd`, the box completes the following steps:

Step 1 : Prepares for disconnection/reconnection and receives the command.
Step 2: Disconnects from the SCSI, reads 112K bytes from the GPIB into the first buffer, then reconnects.
Step 3 : Begins writing the 112K bytes from the first buffer to the SCSI. It also begins reading 88K bytes from the GPIB into the second buffer.
Step 4 : If the SCSI transfer completes before the GPIB transfer, the box disconnects from the SCSI. When the GPIB transfer completes, the box reconnects.
Step 5 : Writes the 88K bytes from the second buffer to the SCSI.
Step 6 : Completes the command.

If the GPIB-SCSI-A detects a condition on the GPIB port that causes a data transfer to abort (such as the END message or Device Clear), it immediately reconnects to the SCSI Initiator. If there is valid GPIB data that remains to be sent out the SCSI, or if Switch 5 of SW2 is OFF (complete SCSI data phases), the GPIB-SCSI-A transfers all of the needed data to or from the SCSI port.

Disconnection/Reconnection while Waiting for GPIB Events

When an Initiator commands the GPIB-SCSI-A to perform a `wait` operation and you want a disconnection/reconnection, perform the following steps:

1. Selection Phase. The Initiator must select the GPIB-SCSI-A with ATN* active to indicate that the Initiator has a message for the GPIB-SCSI-A.

2. Message Out Phase. As soon as the GPIB-SCSI-A is selected and before going into the Command phase, the GPIB-SCSI-A responds to the ATN* signal by going into the Message Out phase. The Initiator then sends the IDENTIFY message with bit 6 (the hex 0x40 bit) set to indicate that it can support disconnection/ reconnection. If this bit is not set, or the Initiator does not issue an IDENTIFY message, the GPIB-SCSI-A does not disconnect/reconnect.

3. Command Phase. After following the Message Out phase, the GPIB-SCSI-A goes into the Command phase to receive the command.

Once you have completed steps 1 through 3, the GPIB-SCSI-A performs the following:

1. The GPIB-SCSI-A disconnects from the SCSI by entering the Message In phase and delivering the SAVE DATA POINTER and DISCONNECT messages to the Initiator signalling its intention to disconnect from the SCSI.

2. Then the GPIB-SCSI-A enters the Bus Free phase by releasing all SCSI signals and waits until any of the conditions occur that have been specified in the `wait` mask.

3. When one of the conditions occurs, the GPIB-SCSI-A arbitrates, gains the SCSI bus, and reselects the Initiator to reconnect. (The Reselection phase is distinguished from the Selection phase by the I/O* signal, which is active during the Reselection phase.)

4. After reconnection, the GPIB-SCSI-A enters the Message In phase and delivers an IDENTIFY message (0x80) to the Initiator.

5. The GPIB-SCSI-A then goes into the Status and Message In phases as required to complete the command.

If the Initiator does not indicate a desire to disconnect while waiting for the GPIB events to occur, the GPIB-SCSI-A will go into the Status phase immediately after it completes the Command phase, and remains in that phase until one of the conditions occurs.

S Mode Default Settings

Table 4-1 lists power-on (default) characteristics of the GPIB-SCSI-A and the functions you can use to change those characteristics.

Table 4-1. GPIB Characteristics

Characteristic	Default Value	Function
Primary/secondary address	pad = switches 4 through 8 of SW1, sad = none	`caddr`
End Of String modes	none	`eos`
Assert EOI* on last byte of writes	yes	`eot`
`ist` bit setting0	`ist`	
GPIB-SCSI-A is System Controller	yes	`rsc`
I/O timeout	10 sec	`tmo`
Serial poll timeout	.1 sec	——
Buffering method	switches 4 and 6 of SW2	`config`
Buffer size	224K	`config`
IEEE 488 Parallel Poll subset	PP1 (remote)	`config`

S Mode Functions

The GPIB-SCSI-A S mode functions are divided into three main groups: GPIB functions, SCSI functions, and General Use functions.

GPIB Function Group

The GPIB functions are divided into subgroups. Table 4-2 lists these subgroups with the most frequently used groups listed first. Often, the I/O and bus management functions are the only ones you need.

Table 4-2. GPIB Function Group

Function	Opcode	Description
I/O Functions:		
`brd`	0xDD	Low-level read GPIB data
`bwrt`	0xDC	Low-level write GPIB data
`rd`	0xCF	High-level read GPIB data
`wrt`	0xDB	High-level write GPIB data
Bus Management Functions:		
`clr`	0xC2	Clear specified device
`lines`	0xC3	Examine the state of the GPIB control lines
`loc`	0xCA	Place specified device in local mode
`trg`	0xD9	Trigger selected device

(continues)

Table 4-2. GPIB Function Group (continued)

Function	Opcode	Description
GPIB Initialization Functions:		
`caddr`	0xC1	Change the IEEE 488 address of the GPIB-SCSI-A
`eos`	0xC5	Change or disable GPIB EOS termination mode
`eot`	0xC6	Enable or disable END termination message on GPIB write operations
`onl`	0xCB	Place the GPIB-SCSI-A online/offline
`rsc`	0xD1	Request System Control
`tmo`	0xD8	Change or disable time limits
Serial Poll Functions:		
`rsp`	0xD3	Conduct (request) a serial poll of specified device
`rsv`	0xD4	Request service and/or set or change the serial poll status byte

(continues)

Table 4-2. GPIB Function Group (continued)

Function	Opcode	Description
Low-Level Controller Functions:		
`cac`	0xC0	Become Active Controller
`cmd`	0xC4	Send IEEE 488 commands
`gts`	0xC7	Go from Active Controller to Standby
`ln`	0xD2	Check for a listening device
`pct`	0xCC	Pass Control
`sic`	0xD5	Assert IFC* for 500 µsec to become Controller-In-Charge
`sre`	0xD6	Set/clear remote enable
Parallel Poll Functions:		
`ist`	0xC9	Set or clear individual status bit for use in GPIB-SCSI-A response to Parallel Polls
`ppc`	0xCD	Parallel Poll Configure
`ppu`	0xCE	Parallel Poll Unconfigure
`rpp`	0xD0	Conduct (request) a Parallel Poll

SCSI Function Group

The SCSI functions are provided to comply with the SCSI specification as well as to provide ways for users to determine internal conditions within the GPIB-SCSI-A. Table 4-3 lists these SCSI functions.

Table 4-3. SCSI Functions

Function	Opcode	Description
`inq`	0x12	Request Inquiry data from GPIB-SCSI-A
`rqsns`	0x03	Request Sense data from GPIB-SCSI-A

General Use Function Group

Table 4-4 lists the General Use functions.

Table 4-4. General Use Functions

Function	Opcode	Description
`id`	0xC8	Identify system
`config`	0xDE	Read or change GPIB-SCSI-A configuration
`stat`	0xD7	Return GPIB-SCSI-A status
`wait`	0xDA	Wait for selected event(s)

Alphabetical List of S Mode Functions

Table 4-5 contains an alphabetical list of all S mode functions.

Table 4-5. GPIB-SCSI-A S Mode Functions

Function	Opcode	Description
brd	0xDD	Low Level read GPIB data
bwrt	0xDC	Low Level write GPIB data
cac	0xC0	Become active controller
caddr	0xC1	Change the IEEE 488 address of the GPIB-SCSI-A
clr	0xC2	Clear specified device
cmd	0xC4	Send IEEE 488 commands
config	0xDE	Read or change GPIB-SCSI-A configuration
eos	0xC5	Change or disable GPIB End-Of-String termination mode
eot	0xC6	Enable or disable END termination message on GPIB write operations
gts	0xC7	Go from Active Controller to Standby
id	0xC8	Identify system
inq	0x12	Request Inquiry data from GPIB-SCSI-A
ist	0xC9	Set or clear individ. status bit for use in GPIB-SCSI-A response to Parallel Polls
lines	0xC3	Examine the state of GPIB control lines

(continues)

Table 4-5. GPIB-SCSI-A S Mode Functions (continued)

Function	Opcode	Description
ln	0xD2	Check for a listening device
loc	0xCA	Place specified device into local mode
onl	0xCB	Place the GPIB-SCSI-A online/offline
pct	0xCC	Pass Control
ppc	0xCD	Parallel Poll Configure
ppu	0xCE	Parallel Poll Unconfigure
rd	0xCF	High Level read GPIB data
rpp	0xD0	Conduct (request) a Parallel Poll
rqsns	0x03	Request Sense data from GPIB-SCSI-A
rsc	0xD1	Request System Control
rsp	0xD3	Conduct (request) a serial poll of device
rsv	0xD4	Request service and/or set or change the serial poll status byte
sic	0xD5	Assert IFC* for 500 µsec
sre	0xD6	Set/clear remote enable
stat	0xD7	Return GPIB-SCSI-A status
tmo	0xD8	Change or disable time limits
trg	0xD9	Trigger selected device
wait	0xDA	Wait for selected event(s)
wrt	0xDB	High Level write GPIB data

Chapter 5
S Mode Functions

This chapter contains a detailed description of each S mode function. These functions are in alphabetical order for easy reference. Each command is presented with the following information:

- The purpose for the command
- The associated Command Descriptor Block (CDB) that the GPIB-SCSI-A uses to interpret the command, along with the meaning of each bit, field, or byte within the CDB
- Additional and related remarks concerning the command
- Information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection
- A description and cause of possible errors
- Programming examples presented algorithmically in a pseudo-code format.

Points to Remember

Consider the following points when reading through the S mode functions:

- The programming examples presented for each command are in an algorithmic format to show you the proper steps required to execute each command. You should substitute in each algorithm the commands required for your system to handle any SCSI activity specified in the algorithm. The algorithms are presented from the point of view of the SCSI Initiator that is trying to communicate with the GPIB-SCSI-A.
- The algorithms are presented to give you an idea of where to start. If used correctly, they will most assuredly work but will not necessarily be the most efficient.

- The SCSI information transfer phases and the programming examples for each command are presented with the assumption that continuous status reporting is disabled. If continuous status reporting is enabled, an extra Message In phase will exist just before the Status phase. For more information on continuous status reporting, see the `stat` command later in this chapter.

- Commands that do not show an example of the GPIB-SCSI-A being selected with the SCSI ATN* signal asserted indicate that the GPIB-SCSI-A does not attempt to disconnect for that particular command.

  Note: The GPIB-SCSI-A responds to the SCSI ATN* signal being asserted during the Selection phase for any command. However, even if the message is the IDENTIFY message and the Initiator is indicating its ability to support disconnection/reconnection, the GPIB-SCSI-A does *not* disconnect with these commands.

- The I/O and bus management functions should meet most of your needs for GPIB activity. In the descriptions that follow, these functions are marked with an asterisk (*). These are the most frequently used functions.

- Any bit, field, or byte in the Command Descriptor Blocks that is marked *Reserved* and is not zero when issued to the GPIB-SCSI-A will cause the GPIB-SCSI-A to abort the command, issue a CHECK CONDITION status response, and set the Sense Key to ILLEGAL REQUEST. For more information on Sense Keys, error indications, and status bytes, see Appendix B, *Status and Message Information*.

- Some knowledge of SCSI is assumed. If you need to acquaint yourself with SCSI, or you need a review of what you know, see Appendix D, *Operation of the SCSI*.

Understanding the Examples

Each command example contains steps for performing that particular command. Within each example, there are various functions. For the sake of brevity, these functions are defined in the following list instead of being defined within each example:

- `Build SCSI Command Descriptor Block (CDB)`
  ```
  Byte 0 = [hex value]
  Byte 1 = [hex value]
  Byte 2 = [hex value]
  Byte 3 = [hex value]
  Byte 4 = [hex value]
  Byte 5 = [hex value]
  ```

  In this step, you should use a data structure that provides six consecutive 8-bit bytes. For example, an array of bytes.

- `SCSIArbitrate`

  Attempt to gain control of the SCSI. If the SCSI is not in the Bus Free phase or there is another Initiator with a higher priority arbitrating, you will *not* gain control of the SCSI.

- `SCSISelect(GPIB-SCSI-A id)`

  Select the GPIB-SCSI-A with the SCSI ATN* signal not asserted.

- `SCSISelectATN(GPIB-SCSI-A id)`

  Select the GPIB-SCSI-A with the SCSI ATN* signal asserted.

- `SCSIMesgOut([IDENTIFY message])`

  If the GPIB-SCSI-A is selected with the ATN* line asserted, the first phase it enters is the Message Out phase. The message sent here should be the IDENTIFY message. If you want to indicate support of disconnection/reconnection, bit 6 in the IDENTIFY message should be set (for example, 0xC0).

- `SCSICmd(CDB)`

  Send the Command Descriptor Block to the GPIB-SCSI-A. The GPIB-SCSI-A interprets the command requested and starts processing the command.

- `SCSIStatus(Sbyte)`

  To indicate the completion of the command, the GPIB-SCSI-A goes into the Status phase to deliver a status byte pertaining to the last command request.

- `SCSIMesgIn(Mbyte)`

  After the Status phase, the GPIB-SCSI-A goes into the Message In phase to deliver a message to the Initiator. This message is always 1 byte long and is always the COMMAND COMPLETE message.

- `ErrorCheck`

  After each command, you should check the status byte to determine the status of the previous command.

- `SCSIRead(databuffer, count)`

  The GPIB-SCSI-A is now in the Data In phase. As an Initiator, you should read data from the SCSI bus. This data comes from the GPIB. Count indicates the number of bytes desired.

- `SCSIWrite(databuffer, count)`

  The GPIB-SCSI-A is now in the Data Out phase. As an Initiator, you should send data from the SCSI bus. This data goes out to the GPIB. Count bytes should be sent.

S Mode Function Descriptions

The remainder of this chapter contains a detailed description of each GPIB-SCSI-A S mode function with examples.

brd - Board Level Read Data

Type: Low-level I/O function

Purpose: Use `brd` to receive data from the GPIB. This command assumes that the GPIB-SCSI-A has been previously addressed to listen.

Format:

Bit / Byte	7	6	5	4	3	2	1	0
0	Opcode = DD_H							
1	Most Significant Byte of Transfer Count							
2	Middle Most Significant Byte of Transfer Count							
3	Middle Least Significant Byte of Transfer Count							
4	Least Significant Byte of Transfer Count							
5	Reserved							

Remarks: Count is a 4-byte unsigned count that represents the number of bytes to read from the GPIB; therefore, Count can represent a number between 0 and 4,294,967,295. The GPIB-SCSI-A reads data from the GPIB until an END condition, count is depleted, or some type of error occurs.

All data received is passed to the SCSI Initiator. If an error occurs with the GPIB, or the GPIB-SCSI-A receives an END condition, the GPIB-SCSI-A stops attempting to transfer data from the GPIB to the SCSI. Instead, the GPIB-SCSI-A finalizes processing of the command according to Switch 5 of configuration switch SW2. If Switch 5 is OFF, the GPIB-SCSI-A pads the data sent back to the SCSI Initiator with nulls (0x00) to equal the exact count requested. If Switch 5 is ON, the GPIB-SCSI-A immediately changes to the Status phase without transferring additional data.

brd (continued)

Depending on the setting of Switch 5, you may have received some bytes that do not represent true GPIB data. Therefore, you should request and analyze the GPIB-SCSI-A status that contains a count equal to the exact number of bytes read from the GPIB. This number represents the number of valid data bytes received.

The `brd` operation terminates when:

- The GPIB-SCSI-A successfully reads all data
- The GPIB-SCSI-A detects an error
- The I/O time limit is exceeded
- The END message is detected
- The EOS character is detected (if this option is enabled)
- Device Clear (DCL) or Selected Device Clear (SDC) command is received from another device that is Controller-In-Charge (CIC).

After `brd` terminates, the GPIB-SCSI-A records the number of data bytes it actually read from the GPIB. If one of the previous events occurs (except for the GPIB-SCSI-A successfully reading all data), the count may be less than expected.

The only possible errors are an EABO (if the I/O time limit is exceeded) or an EADR (if the GPIB-SCSI-A has not been addressed by the Controller to listen). If an error occurs, the GPIB-SCSI-A will abort the command, issue a Check Condition status response, and set the Sense Key to ERROR.

This command is referred to as *Board-Level* because it performs none of the necessary GPIB addressing. All addressing must be done by the CIC of the GPIB, or by the

brd (continued)

user through `cmd` if the GPIB-SCSI-A is CIC and the high-level command, `rd`, does not perform satisfactorily with your device.

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Data In, Status, and Message In phases.

See Also: *eos*, *eot*, *stat*, and *tmo.*

Examples:

1. Use `brd` without the SCSI disconnection/reconnection capability to read 16 bytes from the GPIB.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xDD
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x00
   Byte 4 = 0x10
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIRead(databuffer, 16)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

brd (continued)

2. Use `brd` with the SCSI disconnection/reconnection capability to read 250 bytes from the GPIB.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xDD
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x00
   Byte 4 = 0xFA
   Byte 5 = 0x00

SCSIArbitrate

SCSISelectATN(GPIB-SCSI-A id)

SCSIMesgOut(0xC0)

SCSICmd(CDB)

While Not Done
   While SCSI phase = Data In
         SCSIRead(buffer, 1)
         Increment buffer pointer
   If SCSI phase = Message In
         SCSIMesgIn(Mbyte)
         If Mbyte = SAVE DATA POINTER
              Set up necessary conditions and
              wait to be reconnected by the
              GPIB-SCSI-A.  Upon reconnection,
              the GPIB-SCSI-A enters the Message
              In phase and sends an IDENTIFY
              message of 0x80.  The Data In
              phase should resume.
   If SCSI Phase = Status
         SCSIStatus(Sbyte)
         SCSIMesgIn(Mbyte)
         Done
```

brd (continued)

```
/* In the outer While loop, wait until you
 * are sure that the GPIB-SCSI-A has finished
 * the command.  The only time you can be sure
 * about this is after the final Status and
 * Message In phases.  That is why Done is set
 * in the Status phase condition.  Also, the
 * only phase that can normally follow the
 * Status phase is the Message In phase.  If
 * the Message In phase is not following a
 * Status phase, the GPIB-SCSI-A is notifying
 * the Initiator that it is going to
 * disconnect from the SCSI or, after
 * reconnection, is sending an IDENTIFY
 * message.  As long as the phase is the Data
 * In phase, the GPIB-SCSI-A has data bytes
 * from the GPIB to send to the Initiator.
 */

ErrorCheck
```

bwrt - Board Level Write Data

Type: Low-level I/O Function

Purpose: Use `bwrt` to send data over the GPIB. This command assumes that the GPIB-SCSI-A has been previously addressed to talk.

Format:

Bit / Byte	7	6	5	4	3	2	1	0
0	Opcode = DC_H							
1	Most Significant Byte of Transfer Count							
2	Middle Most Significant Byte of Transfer Count							
3	Middle Least Significant Byte of Transfer Count							
4	Least Significant Byte of Transfer Count							
5	Reserved							

Remarks: Count is a 4-byte unsigned count that represents the number of bytes to write to the GPIB. Therefore, Count can represent a number between 0 and 4,294,967,295.

All data received from the SCSI Initiator during the Data Out phase is passed to the GPIB Listeners. If an error occurs with the GPIB, the GPIB-SCSI-A stops attempting to transfer data from the SCSI to the GPIB. Instead, the GPIB-SCSI-A finalizes processing of the command according to Switch 5 of configuration switch SW2. If Switch 5 is OFF, the GPIB-SCSI-A reads all the data from the SCSI Initiator until the count requested is exhausted. If Switch 5 is ON, the GPIB-SCSI-A immediately changes to the Status phase without transferring additional data.

The `bwrt` operation terminates when one of the following events occurs:

- The GPIB-SCSI-A successfully transfers all data

bwrt (continued)

- The GPIB-SCSI-A detects an error
- The I/O time limit is exceeded
- Device Clear (DCL) or Selected Device Clear (SDC) command is received from another device that is Controller-In-Charge (CIC)

After `bwrt` terminates, the GPIB-SCSI-A records the number of data bytes it actually wrote to the GPIB. If one of the previous events occurs (except for the GPIB-SCSI-A successfully transferring all data), the count may be less than expected.

The only possible errors are EABO (if the I/O time limit is exceeded), EADR (if the GPIB-SCSI-A has not been addressed by the Controller to talk), or ENOL (if there are no Listeners on the GPIB). If an error occurs, the GPIB-SCSI-A aborts the command, issues a Check Condition status response, and sets the Sense Key to ERROR.

This command is referred to as *Board-Level* because it performs none of the necessary GPIB addressing. All addressing must be done by the CIC of the GPIB, or by the user through `cmd` if the GPIB-SCSI-A is CIC and the high-level command, `wrt`, does not perform satisfactorily with your device.

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Data Out, Status, and Message In phases.

See Also: *eos*, *eot*, *stat*, and *tmo*.

bwrt (continued)

Examples:

1. Use `bwrt` without the SCSI disconnection/reconnection capability to write 16 bytes of data to the GPIB.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xDC
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x00
   Byte 4 = 0x10
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIWrite(databuffer, 16)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

2. Use `bwrt` with the SCSI disconnection/reconnection capability to write 250 bytes of data to the GPIB.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xDC
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x00
   Byte 4 = 0xFA
   Byte 5 = 0x00

SCSIArbitrate
```

bwrt (continued)

```
SCSISelectATN(GPIB-SCSI-A id)

SCSIMesgOut(0xC0)

SCSICmd(CDB)

While Not Done
   While SCSI phase = Data Out
         SCSIWrite(buffer, 1)
         Increment buffer pointer
   If SCSI phase = Message In
         SCSIMesgIn(Mbyte)
         If Mbyte = SAVE DATA POINTER
               Set up necessary conditions and
               wait to be reconnected by the
               GPIB-SCSI-A.  Upon reconnection,
               the GPIB-SCSI-A enters the
               Message In phase and sends an
               IDENTIFY message of 0x80.  The
               Data Out phase should resume.
   If SCSI Phase = Status
         SCSIStatus(Sbyte)
         SCSIMesgIn(Mbyte)
         Done

/* In the outer While loop, wait until you
 * are sure that the GPIB-SCSI-A has finished
 * the command.  The only time you can be sure
 * about this is after the final Status and
 * Message In phases.  That is why Done is set
 * in the Status phase condition.  Also, the
 * only phase that can normally follow the
 * Status phase is the Message In phase.  If
 * the Message In phase is not following a
 * Status phase, the GPIB-SCSI-A is notifying
 * the Initiator that it is going to
 * disconnect from the SCSI or after
 * reconnection, is sending an IDENTIFY
```

bwrt (continued)

```
     * message.  As long as the phase is the Data
     * Out phase, the GPIB-SCSI-A is receiving data
     * bytes from the SCSI to send to the GPIB.
     * The count of bytes specified in the CDB
     * should be sent.
     */

    ErrorCheck
```

cac - Become Active Controller

Type: Specialized Controller function

Purpose: Use `cac` to change the GPIB-SCSI-A from Standby Controller to Active Controller when the I/O and bus management functions do not meet your needs. `cac` gives you more precise control over the GPIB than the I/O and bus management functions.

Format:

Bit / Byte	7	6	5	4	3	2	1	0
0	Opcode = $C0_H$							
1	Reserved							
2	Reserved							
3	Reserved							Mode
4	Reserved							
5	Reserved							

Remarks: If Mode is 0, the GPIB-SCSI-A takes control immediately–that is, it takes control asynchronously. If Mode is 1, the GPIB-SCSI-A takes control after any handshake in progress completes–that is, it takes control synchronously.

If you call `cac` and the GPIB-SCSI-A is not Controller-In-Charge (CIC), the GPIB-SCSI-A records the ECIC error, issues a CHECK CONDITION status response, and sets the Sense Key to ERROR.

The power-on default Controller status of the GPIB-SCSI-A is Idle Controller.

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Status, and Message In phases.

See Also: *gts* and *sic.*

cac (continued)

Examples:

Note: Because the only difference between Examples 1 and 2 is the CDB, only the place where the CDB is created is repeated. Example 2 contains the entire program sequence.

1. Request the GPIB to become Active Controller of the GPIB immediately.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xC0
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x00
   Byte 4 = 0x00
   Byte 5 = 0x00
```

2. Request the GPIB-SCSI-A to become Active Controller of the GPIB synchronously.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xC0
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x01
   Byte 4 = 0x00
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

caddr - Change the GPIB Address of the GPIB-SCSI-A

Type: Initialization function

Purpose: Use `caddr` at the beginning of your program to change the GPIB address of the GPIB-SCSI-A from that indicated on configuration switch SW1, or to assign a secondary GPIB address to the GPIB-SCSI-A.

Format:

Bit / Byte	7	6	5	4	3	2	1	0
0	Opcode = $C1_H$							
1	GPIB Primary Address					Reserved		
2	GPIB Secondary Addr. (Opt.)					Mode	Reserved	
3	Reserved							
4	Reserved							
5	Reserved							

Remarks: GPIB Primary Address is a device address that indicates the new GPIB address for the GPIB-SCSI-A. GPIB Secondary Address indicates an optional secondary address for the GPIB-SCSI-A. To indicate that secondary addressing is desired and that the GPIB Secondary Address field contains a valid device address, Mode should be set to 1.

The address assigned by this function remains in effect until you call `caddr` again, call `onl`, or you turn off the GPIB-SCSI-A.

The power-on default GPIB addressing uses Switches 4 through 8 of DIP Switch SW1 for the primary address with secondary addressing disabled.

caddr (continued)

If Mode is 0 and there is anything in the GPIB Secondary Address, the GPIB-SCSI-A will abort the command, issue a CHECK CONDITION status response, and set the Sense Key to ILLEGAL REQUEST.

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Status, and Message In phases.

Examples:

Note: Because the only difference between Examples 1 and 2 is the CDB, only the place where the CDB is created is repeated. Example 2 contains the entire program sequence.

1. Request the GPIB-SCSI-A to change its primary GPIB address to 5, with no secondary addressing. If secondary addressing were enabled, this would disable secondary addressing, too.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xC1
   Byte 1 = 0x28
   Byte 2 = 0x00
   Byte 3 = 0x00
   Byte 4 = 0x00
   Byte 5 = 0x00
```

caddr (continued)

2. Request the GPIB-SCSI-A to change its primary GPIB address to 8, with a secondary address of 2.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xC1
   Byte 1 = 0x40
   Byte 2 = 0x14
   Byte 3 = 0x00
   Byte 4 = 0x00
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

clr - Clear Specified Device*

Type: Bus Management function

Purpose: Use `clr` to reset the internal or device functions of the specified devices. For example, a multimeter might require that you send it the Selected Device Clear (SDC) command to change its function, range, and trigger mode back to its default setting.

Format:

Bit / Byte	7	6	5	4	3	2	1	0
0	Opcode = $C2_H$							
1	GPIB Primary Address					Reserved		
2	GPIB Secondary Addr. (Opt.)					Mode	Reserved	
3	Reserved							
4	Reserved							
5	Reserved							

Remarks: The argument GPIB Primary Address along with the GPIB Secondary Address indicates the address of the device to which the GPIB-SCSI-A issues an SDC command. To indicate that the GPIB Secondary Address contains a valid device address, Mode should be set to 1.

If this is the first function you call that requires GPIB Controller capability and you have not disabled System Controller capability with `rsc`, the GPIB-SCSI-A sends Interface Clear (IFC) to make itself Controller-In-Charge (CIC). It also asserts Remote Enable.

If you passed control to some other GPIB device, control must be passed back to you or you must send IFC to make yourself CIC before making this call. Otherwise, the GPIB-SCSI-A will abort the command, issue a CHECK CONDITION status response, and set the Sense Key to ERROR.

clr (continued)

If Mode is 0 and there is anything in the GPIB Secondary Address, the GPIB-SCSI-A will abort the command, issue a CHECK CONDITION status response, and set the Sense Key to ILLEGAL REQUEST.

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Status, and Message In phases.

See Also: Appendix C, *Operation of the GPIB*, for more information on clearing devices.

Examples:

Note: Because the only difference between Examples 1 and 2 is the CDB, only the place where the CDB is created is repeated. Example 2 contains the entire program sequence.

1. Request the GPIB-SCSI-A to send SDC to the GPIB device with primary address 9, secondary address 5.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xC2
   Byte 1 = 0x48
   Byte 2 = 0x2C
   Byte 3 = 0x00
   Byte 4 = 0x00
   Byte 5 = 0x00
```

clr (continued)

2. Request the GPIB-SCSI-A to send SDC to the GPIB device with primary address 15 and no secondary address.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xC2
   Byte 1 = 0x78
   Byte 2 = 0x00
   Byte 3 = 0x00
   Byte 4 = 0x00
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

cmd - Send GPIB Commands

Type: Specialized Controller function

Purpose: Use `cmd` when the I/O and bus management functions do not meet the needs of your device. `cmd` gives you precise control over the GPIB. For example, in applications that require command sequences not sent by other I/O or bus management functions, `cmd` allows you to transmit any sequence of interface messages (commands) over the GPIB.

Format:

Bit / Byte	7	6	5	4	3	2	1	0
0	Opcode = $C4_H$							
1	Reserved							
2	Reserved							
3	Most Significant Byte of Command Count							
4	Least Significant Byte of Command Count							
5	Reserved							

Remarks: Command Count is a 16-bit unsigned number representing the number of GPIB command bytes (interface messages) to send. These commands are represented by their ASCII character equivalents. For example, the GPIB Untalk (UNT) command is the ASCII character underscore (_).

The GPIB commands, or interface messages, are listed in Appendix A. They include device talk and listen addresses, secondary addresses, messages, device clear and trigger instructions, and other management messages.

Do not use `cmd` to send programming instructions to devices. Use `rd`, `wrt`, `brd`, and `bwrt` to send or receive programming instructions and other device-dependent information.

cmd (continued)

The `cmd` operation terminates when one of the following events occurs:

- The GPIB-SCSI-A successfully transfers all commands
- The GPIB-SCSI-A detects an error
- The I/O time limit is exceeded
- The Take Control (TCT) command is in your command string and is sent to the GPIB
- The Interface Clear (IFC) message is received from the System Controller (not the GPIB-SCSI-A)

After `cmd` terminates, the GPIB-SCSI-A records the number of command bytes it actually sent. If one of the events described above occurs (except for the successful transfer of commands), the count may be less than expected.

The only possible errors are ECIC (if the GPIB-SCSI-A is not Controller-In-Charge (CIC)), ENOL (if there is no device on the bus receiving the command bytes), or EABO (if the I/O time limit is exceeded). If either error occurs, the GPIB-SCSI-A aborts the command, issues a CHECK CONDITION status response, and sets the Sense Key to ERROR.

If the GPIB-SCSI-A is CIC, but not Active Controller, it takes control and asserts ATN* before sending the command bytes. It remains Active Controller afterward.

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Data Out, Status, and Message In phases.

See Also: Appendix A, *Multiline Interface Messages*.

cmd (continued)

Example:

The GPIB-SCSI-A is commanded to send four bytes across the GPIB with the GPIB ATN* signal asserted. This is interpreted as GPIB command data.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xC4
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x00
   Byte 4 = 0x04
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIWrite(cmdbuffer, 4)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

config - Read/Change GPIB-SCSI-A Configuration

Type: General Use function

Purpose: Use `config` when you want the GPIB-SCSI-A to change or report its current operating configuration.

Format:

Bit / Byte	7	6	5	4	3	2	1	0
0	Opcode = DE_H							
1	High 4 bits of Size				Rsvd	PP2	BufMode	
2	Middle Byte of Size							
3	Least Significant Byte of Size							
4	Allocation Length							
5	Reserved							

Remarks: Use this command when you want to find out the current configuration of the GPIB-SCSI-A. You can also use this command to change some of the configuration parameters within the box.

The Allocation Length indicates the number of bytes that the Initiator has allocated for returned configuration data. An Allocation Length of zero indicates that no bytes of configuration data are transferred. Any other value indicates the maximum number of bytes that can be transferred, up to 5. The GPIB-SCSI-A terminates the Data In phase when Allocation Length bytes have transferred or when all available configuration data have transferred to the Initiator, whichever is less.

The PP2 argument is used to indicate what type of parallel poll configurations the GPIB-SCSI-A should accept. If PP2 is 0, the GPIB circuitry of the GPIB-SCSI-A uses the IEEE 488 Parallel Poll (PP) interface function subset PP1 (remote

config (continued)

configuration from an external controller). If PP2 is 1, the GPIB-SCSI-A uses PP subset PP2 (local configuration via the *ppc* function). When PP subset PP2 is used, the GPIB-SCSI-A ignores remote parallel poll configurations.

You can use the BufMode argument to change the buffering method that the GPIB-SCSI-A uses for data transfer during the `brd,bwrt,rd,` and `wrt` commands. See Table 5-1 for proper values of the BufMode argument. For a complete description of each buffering method, refer to the section titled *Buffering Methods* in Chapter 3, *Technical Information*.

Table 5-1. Buffering Methods for Data Transfer Commands

Description	BufMode
Do not change the buffering method.	0
Use the No Buffering method.	1
Use the Single Buffering method.	2
Use the Double Buffering method.	3

The Size argument is used to change the size of the internal buffer used by the GPIB-SCSI-A. This buffer is used by the `brd,bwrt,rd,` and `wrt` commands when Single or Double Buffering is enabled. The actual buffer size is set to the lower of the Size argument and the amount of DRAM available for use. If Size is zero, no change is made to the current buffer size.

The information returned by the GPIB-SCSI-A contains three pieces: the SW2 switch setting, the SW1 switch setting, and the current buffer size.

config (continued)

The GPIB-SCSI-A responds by sending five bytes to the Initiator during the Data In phase representing the following:

- Byte 1: Power-On SW2 configuration
- Byte 2: Power-On SW1 configuration
- Byte 3: High byte of current buffer size
- Byte 4: Middle byte of current buffer size
- Byte 5: Low byte of current buffer size

With the bytes representing SW1 and SW2 configurations, bit 0 of the byte corresponds to Switch 1 and bit 7 corresponds to Switch 8. If the bit is 1, the corresponding switch on the DIP switch is On. For a description of what each switch indicates, refer to the *Configure the Operating Characteristics* section in Chapter 2, *Installation and Configuration of the GPIB-SCSI-A.*

The buffer size returned in bytes 3 to 5 reflects changes made due to the Size argument.

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Data In, Status, and Message In phases.

See Also: *ppc* and Chapter 2, *Installation and Configuration of the GPIB-SCSI-A.*

config (continued)

Example:

Request the GPIB-SCSI-A to return to the Initiator the five bytes of parameter identification. The buffering method used is Single Buffering, and the buffer size is set to 32K. The Parallel Poll subset used by the GPIB-SCSI-A is set to PP1.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xDE
   Byte 1 = 0x02
   Byte 2 = 0x80
   Byte 3 = 0x00
   Byte 4 = 0x05
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIRead(configinfo,5)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

eos - Change/Disable GPIB EOS Termination Mode

Type: Initialization function

Purpose: Use `eos` at the beginning of your program if you want to use an End-Of-String (EOS) mode when you transfer data to and from the GPIB. `eos` tells the GPIB-SCSI-A when to stop reading information from the GPIB. `eos` also enables the GPIB-SCSI-A to tell other devices that it is finished writing information to the GPIB. `eos` defines a specific EOS character to be recognized as a string terminator.

Format:

Bit / Byte	7	6	5	4	3	2	1	0
0	Opcode = $C5_H$							
1	Reserved							
2	Reserved							
3	EOS Mode							
4	ASCII value of EOS Character							
5	Reserved							

Remarks: EOS Mode indicates GPIB termination methods. See Table 5-2 for proper values of the EOS Mode and a description of each bit.

The ASCII value of an EOS character represents a single ASCII character. For example, 10 represents the ASCII linefeed character.

eos (continued)

Table 5-2. Data Transfer Termination Methods

Description	EOS Mode
Terminate read when EOS is detected.	0x04
Set EOI with EOS on write functions.	0x08
Compare all 8 bits of EOS byte rather than low 7 bits (all read and write functions).	0x10
Disable all EOS modes.	0x00

The first and third methods listed in Table 5-2 determine how GPIB read operations performed by the GPIB-SCSI-A terminate. If the first method alone is chosen, reads terminate when the low seven bits of the byte that is read match the low seven bits of ASCII Value of EOS Character. If the first and third methods are chosen, a full 8-bit comparison is used.

The second and third methods listed in Table 5-2 determine when GPIB write operations performed by the GPIB-SCSI-A send the END message. If the second method alone is chosen, the END message is sent automatically with the EOS byte when the low seven bits of that byte match the low seven bits of the EOS character's ASCII value. If the second and third methods are chosen, a full 8-bit comparison is used.

Note: Defining an EOS byte for the GPIB-SCSI-A does not cause the GPIB-SCSI-A to insert that byte into the data string when performing GPIB writes. To send the EOS byte, you must include it in the data string that you send following the `wrt` or `bwrt` programming messages.

By default, no EOS modes are enabled.

eos (continued)

The assignment made by this function remains in effect until you call `eos` again, call `onl`, or you turn off the GPIB-SCSI-A.

If you specify only the third method listed in Table 5-2, the GPIB-SCSI-A will abort the command, issue a CHECK CONDITION status response, and set the Sense Key to ILLEGAL REQUEST.

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Status, and Message In phases.

See Also: *GPIB Read and Write Termination Method* in Chapter 4, *Programming in S Mode*.

Examples:

Note: Because the only difference among Examples 1, 2, and 3 is the CDB, only the place where the CDB is created is repeated. Example 3 contains the entire program sequence.

1. Command the GPIB-SCSI-A to terminate GPIB reads when <LF> is detected with an 8-bit comparison. The GPIB-SCSI-A will not assert EOI* when writing <LF>.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xC5
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x14
   Byte 4 = 0x0A
   Byte 5 = 0x00
```

eos (continued)

2. Command the GPIB-SCSI-A to assert EOI* with a <CR> on GPIB writes and a 7-bit comparison. The GPIB-SCSI-A will not terminate GPIB reads when <CR> is detected.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xC5
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x08
   Byte 4 = 0x0D
   Byte 5 = 0x00
```

3. Command the GPIB-SCSI-A to disable all EOS modes.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xC5
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x00
   Byte 4 = 0x00
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

eot - Enable/Disable END Message on GPIB Writes

Type: Initialization function

Purpose: Use `eot` at the beginning of your program if you want to change how the GPIB-SCSI-A terminates GPIB writes. Using `eot`, you tell the GPIB-SCSI-A to automatically send or not send the GPIB END message with the last byte that it writes to the GPIB.

Format:

Bit / Byte	7	6	5	4	3	2	1	0
0	Opcode = $C6_H$							
1	Reserved							
2	Reserved							
3	Reserved							Mode
4	Reserved							
5	Reserved							

Remarks: If Mode is 1, the GPIB-SCSI-A automatically sends the END message with the last byte of each `wrt`. If Mode is 0, END is not sent. The power-on default is 1.

The assignment made by `eot` remains in effect until you call `eot` again, call `onl`, or you turn off the GPIB-SCSI-A.

The GPIB-SCSI-A sends the END message by asserting the GPIB EOI* signal during the last byte of a data transfer. `eot` is used primarily to send variable length data.

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Status, and Message In phases.

See Also: *GPIB Read and Write Termination Method* in Chapter 4, *Programming in S Mode.*

eot (continued)

Examples:

Note: Because the only difference between Examples 1 and 2 is the CDB, only the place where the CDB is created is repeated. Example 2 contains the entire program sequence.

1. Request the GPIB-SCSI-A to not assert the GPIB EOI* signal with the last byte of GPIB writes.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xC6
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x00
   Byte 4 = 0x00
   Byte 5 = 0x00
```

2. Request the GPIB-SCSI-A to assert the GPIB EOI* signal with the last byte of GPIB writes.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xC6
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x01
   Byte 4 = 0x00
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

gts - Go from Active Controller to Standby

Type: Specialized Controller function

Purpose: Use `gts` to change the GPIB-SCSI-A from Active Controller to Standby Controller or if the I/O and bus management functions do not meet the needs of your device. For example, use `gts` if you want to allow two external devices to talk to each other directly. The GPIB-SCSI-A can selectively participate in the handshake of the data transfer and hold off the handshake when it detects the END message. The GPIB-SCSI-A can then take control synchronously without possibly corrupting the transfer.

Format:

Bit / Byte	7	6	5	4	3	2	1	0
0	Opcode = $C7_H$							
1	Reserved							
2	Reserved							
3	Reserved							Mode
4	Reserved							
5	Reserved							

Remarks: If Mode is 1, shadow handshaking is enabled. If Mode is 0, shadow handshaking is not performed.

`gts` causes the GPIB-SCSI-A to go to the Controller Standby state and to unassert the ATN* signal if it is initially the Active Controller. `gts` permits GPIB devices to transfer data without the GPIB-SCSI-A participating in the transfer.

If you enable shadow handshaking, the GPIB-SCSI-A participates in the data handshake as an Acceptor without actually reading the data. It monitors the transfers for the END (EOI* or EOS character) message and holds off subsequent transfers. By using this mechanism, the GPIB-SCSI-A can take control synchronously on a subsequent operation such as `cmd` or `rpp`.

gts (continued)

Before performing a `gts` with a shadow handshake, you should call EOS to establish the proper End-Of-String character or to disable the EOS detection if the End-Of-String character used by the Talker is not known.

If you call `gts` and the GPIB-SCSI-A is not Controller-In-Charge (CIC), the GPIB-SCSI-A records the ECIC error, issues a CHECK CONDITION status response, and sets the Sense Key to ERROR.

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Status, and Message In phases.

See Also: *cac.*

Examples:

Note: Because the only difference between Examples 1 and 2 is the CDB, only the place where the CDB is created is repeated. Example 2 contains the entire program sequence.

1. Request the GPIB-SCSI-A to become Standby Controller.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xC7
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x00
   Byte 4 = 0x00
   Byte 5 = 0x00
```

gts (continued)

2. Request the GPIB-SCSI-A to become Standby Controller and shadow handshake the data on the GPIB.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xC7
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x01
   Byte 4 = 0x00
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

id - Identify System

Type: General Use function

Purpose: Use `id` if you want to know the revision level of your firmware, or if you want to know how much DRAM is installed in your GPIB-SCSI-A.

Format:

Bit / Byte	7	6	5	4	3	2	1	0
0	Opcode = $C8_H$							
1	Reserved							
2	Reserved							
3	Reserved							
4	Allocation Length							
5	Reserved							

Remarks: The Allocation Length specifies the number of bytes that the Initiator has allocated for returned identification data. An Allocation Length of zero indicates that no bytes of identification data are transferred. Any other value indicates the maximum number of bytes that are transferred, up to 75. The GPIB-SCSI-A terminates the Data In phase when Allocation Length bytes have transferred or when all available identification data have transferred to the Initiator, whichever is less.

The identification is returned in 75 bytes, consisting of three substrings separated by a <CR><LF> pair. The first two strings identify the company product model, the software revision level, and a copyright notice. The third string identifies the number of bytes of DRAM in the GPIB-SCSI-A that are available for use as buffer space.

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Data In, Status, and Message In phases.

id (continued)

Example:

1. Request the GPIB-SCSI-A to return the System Identification strings to the Initiator during the Data In phase.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xC8
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x00
   Byte 4 = 0x4B
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIRead(databuffer, 75)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

inq - Inquiry

Type: General Use function

Purpose: Use `inq` to request information detailing fixed operating parameters and device identification of the GPIB-SCSI-A.

Format:

Bit / Byte	7	6	5	4	3	2	1	0
0	Opcode = 12_H							
1	Reserved							
2	Reserved							
3	Reserved							
4	Allocation Length							
5	Reserved							

Remarks: The Allocation Length indicates the number of bytes that the Initiator has allocated for returned inquiry data. An Allocation Length of zero indicates that no bytes of inquiry data are transferred. Any other value indicates the maximum number of bytes that are transferred, up to 49. The GPIB-SCSI-A terminates the Data In phase when Allocation Length bytes have transferred or when all available inquiry data have transferred to the Initiator, whichever is less. Listed in Table 5-3 is the format for the GPIB-SCSI-A's inquiry data along with a description about each byte.

inq (continued)

Table 5-3. Inquiry Data Format for the GPIB-SCSI-A

Byte	Value	Description
0	9FH	Peripheral Device Type
1	0	Device Type Qualifier
2	1	ISO Version 0, ECMA Version 0, ANSI Approved Version 1
3	2	SCSI-2 Inquiry Data Format
4	2CH	Additional Inquiry Data Bytes
5	0	Reserved
6	0	Reserved
7	0	Reserved
8-15		Vendor ID in ASCII, "N. I. "
16-31		Product ID in ASCII, "GPIB-SCSI-A "
32-35		Revision level in ASCII, "x.y " where x represents a major revision letter, and y represents a minor revision number
36, 37	0	Number of extents
38	0	Bit map of Group 0 commands supported

(continues)

inq (continued)

Table 5-3. Inquiry Data Format for the GPIB-SCSI-A (continued)

Byte	Value	Description
39	8	Command 3, Request Sense
40	0	No commands in this range
41	4	Command 18, Inquiry
42	0	No commands in this range
43	6	Bit map of Group 6 (Vendor Unique) commands supported
44	FFH	Commands 0-7
45	FFH	Commands 8-15
46	FFH	Commands 16-23
47	FFH	Commands 24-31
48	FFH	End of list indicator

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Data In, Status, and Message In phases.

inq (continued)

Example:

Request the GPIB-SCSI-A to return 49 bytes of inquiry data to the Initiator during the Data In phase.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0x12
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x00
   Byte 4 = 0x31
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIRead(databuffer, 49)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

ist - Set or Clear Individual Status Bit

Type: Parallel Poll function

Purpose: Use `ist` when the GPIB-SCSI-A participates in a parallel poll that is conducted by another device that is Active Controller.

Format:

Bit / Byte	7	6	5	4	3	2	1	0
0	Opcode = $C9_H$							
1	Reserved							
2	Reserved							
3	Reserved							Mode
4	Reserved							
5	Reserved							

Remarks: If Mode is 1, the individual status bit of the GPIB-SCSI-A is set to 1. If Mode is 0, the individual status bit of the GPIB-SCSI-A is cleared. The power-on default is 0.

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Data In, Status, and Message In phases.

See Also: *ppc* and Appendix E, *Parallel Polling.*

ist (continued)

Examples:

Note: Because the only difference between Examples 1 and 2 is the CDB, only the place where the CDB is created is repeated. Example 2 contains the entire program sequence.

1. Request the GPIB-SCSI-A to clear its Individual Status bit.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xC9
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x00
   Byte 4 = 0x00
   Byte 5 = 0x00
```

2. Request the GPIB-SCSI-A to set its Individual Status bit.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xC9
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x01
   Byte 4 = 0x00
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

lines - Return the State of the Eight GPIB Control Lines

Type: Bus Management function

Purpose: This command is used to determine the state of the eight GPIB control lines.

Format:

Bit / Byte	7	6	5	4	3	2	1	0
0	Opcode = $C3_H$							
1	Reserved							
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							

Remarks: This command returns two bytes of information. The state of the eight GPIB control lines is returned in the first byte, as follows :

7	6	5	4	3	2	1	0
EOI	ATN	SRQ	REN	IFC	NRFD	NDAC	DAV

The second byte contains mask bits in the same order as above, indicating which lines are actually being reported, and which are undeterminable. If a particular mask bit is 1, then the corresponding bit in the first byte indicates the state of that line. If the mask bit is 0, then the corresponding bit in the first byte should be disregarded.

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Data In, Status, and Message In phases.

lines (continued)

Example:

Request the GPIB-SCSI-A to return the current state of the eight GPIB control lines.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xC3
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x00
   Byte 4 = 0x00
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIRead(linesinfo,2)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

ln - Check for the Presence of a Listening Device on the Bus

Type: Specialized Controller function.

Purpose: This command is used to determine whether or not there is a listening device at the specified address.

Format:

Byte \ Bit	7	6	5	4	3	2	1	0
0	Opcode = $D2_H$							
1	GPIB Primary Address					Reserved		
2	GPIB Secondary Addr. (Opt.)					Mode	Reserved	
3	Reserved							
4	Reserved							
5	Reserved							

Remarks: This command determines whether or not there is a listening device at the GPIB address specified by the GPIB Primary Address and the GPIB Secondary Address arguments. To indicate that the GPIB Secondary Address contains a valid device address, Mode must be set to 1.

This command returns one byte of data. If the device at the specified address is listening, the byte has a non-zero value. If there is no listening device at the specified address, a zero is returned.

If Mode is 1, and the GPIB Secondary Address argument has the value 31 (1F hex), the byte returned from the command reflects whether a listening device is present on any of the secondary addresses associated with the specified GPIB Primary Address.

If this is the first function you call that requires GPIB Controller capability, and you have not disabled System Controller capability with `rsc`, the GPIB-SCSI-A sends

ln (continued)

Interface Clear (IFC) to make itself Controller-In-Charge (CIC). It also asserts Remote Enable.

If Mode is 0 and there is anything in the GPIB Secondary Address, the GPIB-SCSI-A aborts the command, issues a CHECK CONDITION status response, and sets the Sense Key to ILLEGAL REQUEST.

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Data In, Status, and Message In phases.

Example:

1. Request the GPIB-SCSI-A to detect if there are any GPIB devices located at primary address 1. All secondary addresses are checked.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xD2
   Byte 1 = 0x08
   Byte 2 = 0xFC
   Byte 3 = 0x00
   Byte 4 = 0x00
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIRead(lnstatus,1)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

loc - Go to Local *

Type: Bus Management function

Purpose: Use `loc` to put a device in local program mode. In this mode you can program the device from its front panel. Because a device usually must be placed in remote program mode before it can be programmed from the GPIB, the GPIB-SCSI-A automatically puts the device in remote program mode. You then use `loc` to return devices to local program mode.

Format:

Bit / Byte	7	6	5	4	3	2	1	0
0	Opcode = CA_H							
1	GPIB Primary Address					Reserved		
2	GPIB Secondary Addr. (Opt.)					Mode	Reserved	
3	Reserved							Me
4	Reserved							
5	Reserved							

Remarks: This function is used to configure a specified device for local program mode. It can be used to configure the GPIB-SCSI-A as well as other devices. When the Me bit is 0, the GPIB-SCSI-A configures another device. When the Me bit is 1, the GPIB-SCSI-A configures itself.

The following paragraphs apply when configuring another device (Me bit is 0):

The argument GPIB Primary Address along with GPIB Secondary Address indicates the address of the device to which the GPIB-SCSI-A issues a Go To Local (GTL) command. To indicate that the GPIB Secondary Address contains a valid device address, Mode must be set to 1.

If this is the first function you call that requires GPIB Controller capability, and you have not disabled System Controller capability with `rsc`, the GPIB-SCSI-A sends

loc (continued)

Interface Clear (IFC) to make itself Controller-In-Charge (CIC). It also asserts Remote Enable.

If you passed control to some other GPIB device, control must be passed back to you or you must send IFC to make yourself CIC before making this call. Otherwise, the GPIB-SCSI-A aborts the command, issues a CHECK CONDITION status response, and sets the Sense Key to ERROR.

If Mode is 0 and there is anything in the GPIB Secondary Address, the GPIB-SCSI-A aborts the command, issues a CHECK CONDITION status response, and sets the Sense Key to ILLEGAL REQUEST.

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Status, and Message In phases.

The following paragraphs apply when configuring the GPIB-SCSI-A (Me bit is 1):

The GPIB-SCSI-A configures itself for local program mode by pulsing its rtl (return to local) message.

The arguments GPIB Primary Address, GPIB Secondary Address, and Mode are ignored when the Me bit is 1, because the GPIB-SCSI-A is configuring itself.

The GPIB-SCSI-A does not require GPIB controller capability in order to configure itself for local program mode.

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Status, and Message In phases.

loc (continued)

Examples:

Note: Because the only difference between Examples 1 and 2 is the CDB, only the place where the CDB is created is repeated. Example 2 contains the entire program sequence.

1. Request the GPIB-SCSI-A to send the Go To Local (GTL) command to the GPIB device with primary address 1, secondary address 2.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xCA
   Byte 1 = 0x08
   Byte 2 = 0x14
   Byte 3 = 0x00
   Byte 4 = 0x00
   Byte 5 = 0x00
```

2. Request the GPIB-SCSI-A to configure itself for local program mode.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xCA
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x01
   Byte 4 = 0x00
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect (GPIB-SCSI-A id)

SCSICmd (CDB)

SCSIStatus (Sbyte)

SCSIMesgIn (Mbyte)

ErrorCheck
```

onl - Place the GPIB-SCSI-A Online/Offline

Type: Initialization function

Purpose: Use `onl` to disable communications between the GPIB-SCSI-A and the GPIB, or to re-initialize the GPIB-SCSI-A characteristics to their default values.

Format:

Bit / Byte	7	6	5	4	3	2	1	0
0	Opcode = CB_H							
1	Reserved							
2	Reserved							
3	Reserved							Mode
4	Reserved							
5	Reserved							

Remarks: If Mode is 1, the GPIB-SCSI-A places itself online. If Mode is 0, the GPIB-SCSI-A places itself offline. By default, the GPIB-SCSI-A powers up online, is in the Idle Controller state, and configures itself to be the System Controller.

Placing the GPIB-SCSI-A offline can be thought of as disconnecting its GPIB cable from the other GPIB devices.

Placing the GPIB-SCSI-A online allows the GPIB-SCSI-A to communicate over the GPIB, and also restores all GPIB-SCSI-A settings to their power-on values.

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Status, and Message In phases.

See Also: Table 4-1 for the GPIB-SCSI-A default settings.

onl (continued)

Examples:

Note: Because the only difference between Examples 1 and 2 is the CDB, only the place where the CDB is created is repeated. Example 2 contains the entire program sequence.

1. Request the GPIB-SCSI-A to go offline. This means that the GPIB-SCSI-A ignores all GPIB activity, just as if the GPIB cable were removed from the GPIB-SCSI-A.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xCB
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x00
   Byte 4 = 0x00
   Byte 5 = 0x00
```

2. Request the GPIB-SCSI-A to come back online and reset certain operating characteristics back to their default conditions.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xCB
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x01
   Byte 4 = 0x00
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

pct - Pass Control

Type: Specialized Controller function

Purpose: Use `pct` to pass Controller-In-Charge (CIC) authority from the GPIB-SCSI-A to some other device.

Format:

Bit / Byte	7	6	5	4	3	2	1	0
0	Opcode = CC_H							
1	GPIB Primary Address						Reserved	
2	GPIB Secondary Addr. (Opt.)					Mode	Reserved	
3	Reserved							
4	Reserved							
5	Reserved							

Remarks: If you call `pct` and the GPIB-SCSI-A is not Controller-In-Charge (CIC), the GPIB-SCSI-A records the ECIC error, issues a CHECK CONDITION status response, and sets the Sense Key to ERROR.

If Mode is 0 and there is anything in the GPIB Secondary Address, the GPIB-SCSI-A aborts the command, issues a CHECK CONDITION status response, and sets the Sense Key to ILLEGAL REQUEST.

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Status, and Message In phases.

pct (continued)

Examples:

Note: Because the only difference between Examples 1 and 2 is the CDB, only the place where the CDB is created is repeated. Example 2 contains the entire program sequence.

1. Request the GPIB-SCSI-A to send TCT to the GPIB device with primary address 3, secondary address 0.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xCC
   Byte 1 = 0x18
   Byte 2 = 0x04
   Byte 3 = 0x00
   Byte 4 = 0x00
   Byte 5 = 0x00
```

2. Request the GPIB-SCSI-A to send TCT to the GPIB device with primary address 12 with no secondary address.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xCA
   Byte 1 = 0x60
   Byte 2 = 0x00
   Byte 3 = 0x00
   Byte 4 = 0x00
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

ppc - Parallel Poll Configure

Type: Parallel Poll function

Purpose: Use ppc to configure specified devices to respond to parallel polls in a certain manner.

Format:

Bit / Byte	7	6	5	4	3	2	1	0
0	Opcode = CD_H							
1	GPIB Primary Address					Reserved		
2	GPIB Secondary Addr. (Opt.)					Mode	Reserved	
3	Reserved							Me
4	Parallel Poll Enable Message							
5	Reserved							

Remarks: This function is used to configure a specified device to respond to parallel polls in a certain manner. It can be used to configure the GPIB-SCSI-A as well as other devices. When the Me bit is 0, the GPIB-SCSI-A configures another device. When the Me bit is 1, the GPIB-SCSI-A configures itself.

The following paragraphs apply when configuring another device (Me bit is 0):

In order for the specified device to properly accept the parallel poll configuration issued by the GPIB-SCSI-A, that device must be configured to accept remote parallel poll configurations. Thus, the specified device must be using IEEE 488 Parallel Poll (PP) interface function subset PP1. If the specified device is configured to accept parallel poll configurations using PP subset PP2 (local configuration), it will probably ignore the configuration sent by the GPIB-SCSI-A.

The argument GPIB Primary Address along with GPIB Secondary Address indicates the address of the device which the GPIB-SCSI-A will configure. To indicate that the GPIB

ppc (continued)

Secondary Address contains a valid device address, Mode must be set to 1.

The GPIB-SCSI-A configures the specified device by issuing a Parallel Poll Configure (PPC) command followed by the command contained in the Parallel Poll Message argument. The Parallel Poll Message is a byte in the range of 60 to 7E hex, where 60 to 6F hex are Parallel Poll Enable (PPE) messages and 70 to 7E hex are Parallel Poll Disable (PPD) messages.

If this is the first function you call that requires GPIB controller capability, and you have not disabled System Controller capability with `rsc`, the GPIB-SCSI-A sends Interface Clear (IFC*) to make itself Controller-In-Charge (CIC). It also asserts Remote Enable.

If you passed control to some other GPIB device, control must be passed back to you or you must send IFC to make yourself CIC before making this call. Otherwise, the GPIB-SCSI-A aborts the command, issues a CHECK CONDITION status response, and sets the Sense Key to ERROR.

If Mode is 0 and there is anything in the GPIB Secondary Address, the GPIB-SCSI-A aborts the command, issues a CHECK CONDITION status response, and sets the Sense Key to ILLEGAL REQUEST.

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Status, and Message In phases.

The following paragraphs apply when configuring the GPIB-SCSI-A (Me bit is 1):

In order for the GPIB-SCSI-A to configure itself for parallel polls, it must be configured to accept local parallel poll configurations. Thus, the GPIB-SCSI-A must be using IEEE 488 Parallel Poll (PP) interface function subset PP2. This can be done by setting the PP2 bit in the *config* function. If the GPIB-SCSI-A is configured to accept parallel poll

ppc (continued)

configurations using PP subset PP1 (remote configuration), it records the ECAP error. If this error occurs, the GPIB-SCSI-A aborts the command, issues a CHECK CONDITION status response, and sets the Sense Key to ERROR.

The arguments GPIB Primary Address, GPIB Secondary Address, and Mode are ignored when the Me bit is 1, because the GPIB-SCSI-A is configuring itself.

The GPIB-SCSI-A configures itself using the value contained in the Parallel Poll Message argument. The Parallel Poll Message is a byte in the range of 60 to 7E hex, where 60 to 6F hex are Parallel Poll Enable (PPE) messages and 70 to 7E hex are Parallel Poll Disable (PPD) messages.

The GPIB-SCSI-A does not require GPIB controller capability in order to configure itself for parallel polls.

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Status, and Message In phases.

See Also: *config*, *ist*, *ppu*, *rpp*, and Appendix E, *Parallel Polling.*

Examples:

Note: Because the only difference between Examples 1, 2, and 3 is the CDB, only the place where the CDB is created is repeated. Example 3 contains the entire program sequence.

1. Request the GPIB-SCSI-A to configure the device at primary address 24 to respond on GPIB data line 7 when its individual status (ist) bit is set.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xCD
   Byte 1 = 0xC0
   Byte 2 = 0x00
```

ppc (continued)

```
   Byte 3 = 0x00
   Byte 4 = 0x6E
   Byte 5 = 0x00
```

2. Request the GPIB-SCSI-A to disable the device at primary address 1 from responding to parallel polls.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xCD
   Byte 1 = 0x08
   Byte 2 = 0x00
   Byte 3 = 0x00
   Byte 4 = 0x70
   Byte 5 = 0x00
```

3. Request the GPIB-SCSI-A to configure itself to respond on GPIB data line 1 when its individual status (ist) bit is cleared.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xCD
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x01
   Byte 4 = 0x60
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

ppu - Parallel Poll Unconfigure

Type: Parallel Poll function

Purpose: Use `ppu` to unconfigure all devices from responding to parallel polls.

Format:

Byte \ Bit	7	6	5	4	3	2	1	0
0	Opcode = CE_H							
1	Reserved							
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							

Remarks: This function causes the GPIB Parallel Poll Unconfigure (PPU) message to be sent. This message unconfigures all devices from responding to parallel polls. This function should be used only if you want to unconfigure all devices. If you want to unconfigure only one device, the `ppc` function should be used to send a parallel poll disable message to that device.

If this is the first function you call that requires GPIB controller capability, and you have not disabled System Controller capability with `rsc`, the GPIB-SCSI-A sends Interface Clear (IFC*) to make itself Controller-In-Charge (CIC). It also asserts Remote Enable.

If you passed control to some other GPIB device, control must be passed back to you or you must send IFC to make yourself CIC before making this call. Otherwise, the GPIB-SCSI-A aborts the command, issues a CHECK CONDITION status response, and sets the Sense Key to ERROR.

ppu (continued)

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Status, and Message In phases.

See Also: *ist*, *ppc*, *rpp*, and Appendix E, *Parallel Polling.*

Example:

Request the GPIB-SCSI-A unconfigure the devices from responding to parallel polls.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xCE
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x00
   Byte 4 = 0x00
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

rd - Read Data *

Type: High-level I/O function

Purpose: Use `rd` to read data from the GPIB. All GPIB addressing is performed automatically.

Format:

Bit / Byte	7	6	5	4	3	2	1	0
0	Opcode = CF_H							
1	GPIB Primary Address						High 3 bits of Cnt	
2	GPIB Secondary Addr. (Opt.)					Mode	2 bits of Cnt	
3	Middle Byte of Count							
4	Least Significant Byte of Count							
5	Reserved							

Remarks: The argument GPIB Primary Address along with the GPIB Secondary Address indicates the address of the device from which the GPIB-SCSI-A attempts to read data. To indicate that the GPIB Secondary Address contains a valid device address, Mode must be set to 1. Count is a 21-bit unsigned count that represents the number of bytes to read. Therefore, Count can represent a number between 0 and 2,097,152.

All data received is passed to the SCSI Initiator. If an error occurs with the GPIB, or the GPIB-SCSI-A receives an END condition, the GPIB-SCSI-A stops attempting to transfer data from the GPIB to the SCSI. Instead, the GPIB-SCSI-A finalizes processing of the command according to Switch 5 of configuration switch SW2. If Switch 5 is OFF, the GPIB-SCSI-A pads the data sent back to the SCSI Initiator with nulls (0x00) to equal the exact count requested. If Switch 5 is ON, the GPIB-SCSI-A immediately changes to the Status phase without transferring additional data.

Depending on the setting of Switch 5 on configuration Switch SW2, you may have received some null bytes that do not represent true GPIB data. Therefore, you should request and

rd (continued)

analyze the GPIB-SCSI-A status that contains a count equal to the exact number of bytes read from the GPIB. This number represents the number of valid data bytes received.

The `rd` operation terminates when:

- The GPIB-SCSI-A successfully reads all data.
- The GPIB-SCSI-A detects an error.
- The I/O time limit is exceeded.
- The END message is detected.
- The EOS character is detected (if this option is enabled).
- The Device Clear (DCL) or Selected Device Clear (SDC) command is received from another device that is Controller-In-Charge (CIC).

After `rd` terminates, the GPIB-SCSI-A records the number of data bytes it actually read from the GPIB. If one of the events above occurs (except if the GPIB-SCSI-A successfully reads all data), the count may be less than expected.

If the GPIB-SCSI-A is CIC, `rd` causes the GPIB-SCSI-A to address itself to listen if it is not already addressed. The GPIB-SCSI-A also addresses the device indicated by the address values in the CDB to talk.

The GPIB-SCSI-A then places itself in Standby Controller state with ATN* off and remains there after the read operation is complete.

The GPIB-SCSI-A must be CIC to perform the addressing. If this is the first function you call that requires GPIB Controller capability, and you have not disabled System Controller capability with `rsc`, the GPIB-SCSI-A sends Interface Clear (IFC*) to make itself CIC. It also asserts Remote Enable.

rd (continued)

The only possible errors are EABO (if the I/O time limit is exceeded), ECIC (if you passed control to some other GPIB device and control has not been returned to you or you have not sent IFC* to make yourself CIC before making this call), or EBUS (if the command bytes used for addressing cannot be sent out). If an error occurs, the GPIB-SCSI-A aborts the command, issues a CHECK CONDITION status response, and sets the Sense Key to ERROR.

If Mode is 0 and there is anything in the GPIB Secondary Address, the GPIB-SCSI-A will abort the command, issue a CHECK CONDITION status response, and set the Sense Key to ILLEGAL REQUEST.

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Data In, Status, and Message In phases.

See Also: *eos*, *eot*, *stat*, and *tmo*.

rd (continued)

Examples:

1. Use `rd` without the SCSI disconnection/reconnection capability to read 1,350 bytes from the GPIB device at primary address 4 and no secondary address.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xCF
   Byte 1 = 0x20
   Byte 2 = 0x00
   Byte 3 = 0x05
   Byte 4 = 0x46
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIRead(databuffer, 1350)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

rd (continued)

2. Use `rd` with the SCSI disconnection/reconnection capability to read 34,300 bytes from the GPIB device at primary address 2 and secondary address 10.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xCF
   Byte 1 = 0x10
   Byte 2 = 0x54
   Byte 3 = 0x85
   Byte 4 = 0xFC
   Byte 5 = 0x00

SCSIArbitrate

SCSISelectATN(GPIB-SCSI-A id)

SCSIMesgOut(0xc0)

SCSICmd(CDB)

While Not Done
   While SCSI phase = Data In
         SCSIRead(buffer, 1)
         Increment buffer pointer
   If SCSI phase = Message In
         SCSIMesgIn(Mbyte)
         If Mbyte = SAVE DATA POINTER
               Set up necessary conditions and
               wait to be reconnected by the
               GPIB-SCSI-A.  Upon reconnection,
               the GPIB-SCSI-A enters the
               Message In phase and sends an
               IDENTIFY message of 0x80.  The
               Data In phase should resume.
```

rd (continued)

```
      If SCSI Phase = Status
            SCSIStatus(Sbyte)
            SCSIMesgIn(Mbyte)
            Done

   /* In the outer While loop, wait until you are
    * sure that the GPIB-SCSI-A has finished the
    * command, which is after the Status and
    * Message In phases.  That is why Done is set
    * in the Status phase condition.  Also, the
    * only phase that can normally follow the
    * Status phase is the Message In phase.  If
    * the Message In phase is not following a
    * Status phase, the GPIB-SCSI-A is notifying
    * the Initiator that it is going to disconnect
    * from the SCSI or, after reconnection, is
    * sending the IDENTIFY message.  As long as
    * the phase is the Data In phase, the
    * GPIB-SCSI-A has data bytes from the GPIB to
    * send to the Initiator.
    */

   ErrorCheck
```

rpp - Request (Conduct) a Parallel Poll

Type: Parallel Poll function

Purpose: Use `rpp` if you want to conduct a parallel poll to obtain information from several devices at the same time.

Format:

Bit / Byte	7	6	5	4	3	2	1	0
0	Opcode = $D0_H$							
1	Reserved							
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							

Remarks: `rpp` causes the GPIB-SCSI-A to conduct a parallel poll of previously configured devices by sending the IDY message (ATN* and EOI* both asserted) and reading the response from the GPIB data lines. The GPIB-SCSI-A pulses the IDY message for greater than or equal to 2 µsec and expects valid responses within that time. It remains Active Controller afterward.

The GPIB-SCSI-A returns the Parallel Poll Response (PPR) following the poll in the form of a 1 byte binary number during the Data In phase.

If this is the first function you call that requires GPIB Controller capability and you have not disabled System Controller capability with `rsc`, the GPIB-SCSI-A sends Interface Clear (IFC*) to make itself Controller-In-Charge (CIC). It also asserts Remote Enable.

rpp (continued)

If you passed control to some other GPIB device, control must be passed back to you or you must send IFC* to make yourself CIC before making this call. Otherwise, the GPIB-SCSI-A aborts the command, issues a CHECK CONDITION status response, and sets the Sense Key to ERROR.

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Data In, Status, and Message In phases.

See Also: *ist*, *ppc*, *ppu*, and Appendix E, *Parallel Polling.*

Examples:

Request the GPIB-SCSI-A to execute a Parallel Poll on the GPIB. The response is returned during the Data In phase as one unsigned byte.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xD0
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x00
   Byte 4 = 0x00
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIRead(ppresp, 1)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

rqsns - Request Sense

Type: General Use function

Purpose: Use `rqsns` when you want the GPIB-SCSI-A to report its sense data to detail problems that have occurred.

Format:

Bit / Byte	7	6	5	4	3	2	1	0
0	Opcode = 03_H							
1	Reserved							
2	Reserved							
3	Reserved							
4	Allocation Length							
5	Reserved							

Remarks: The Allocation Length indicates the number of bytes that the Initiator has allocated for returned sense data. An Allocation Length of zero indicates that no data is transferred. This condition should not be considered an error. Any other value indicates the maximum number of bytes that are transferred, up to 22. The GPIB-SCSI-A terminates the Data In phase when Allocation Length bytes have transferred or when all available sense data has transferred to the Initiator, whichever is less.

rqsns (continued)

Table 5-4 contains the format for the Sense data of the GPIB-SCSI-A along with a description about each byte.

Table 5-4. Sense Data Format for the GPIB-SCSI-A

Byte	Value	Description
0	70H	Error class 7, code 0
1	0	Segment number
2	x	Sense key, describes error condition
3 - 6	0	Information
7	14	Additional Sense Length
8	x	GPIB error indicator `iberr` as in that returned by `stat`.
9	x	SCSI error indicator `scerr`, as in that returned by `stat`.
10 - 11	x	GPIB-SCSI-A status, as in that returned by `stat`.
12 - 17	0	Reserved
18 - 21	x	Count of bytes transferred, as in that returned by `stat`.

rqsns (continued)

Table 5-5 lists the possible Sense Keys that can be returned in byte 2 of the sense data. It also includes a description of what each sense key indicates.

Table 5-5. GPIB-SCSI-A Sense Keys

Sense Key	Description
0	No Sense Key
5	Illegal Request Indicates that there was an illegal opcode or parameter in the Command Descriptor Block.
9	Error Indicates that the GPIB-SCSI-A encountered some error on the last command. You may use bytes 8 - 11 of the returned sense data to discover what problem occurred and what action to take.
11	Aborted Command Indicates that the GPIB-SCSI-A aborted the command. You may be able to recover by trying the command again.

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Data In, Status, and Message In phases.

See Also: *stat* and Appendix B, *Status and Message Information,* for more information on Sense Keys.

rqsns (continued)

Example:

Request the GPIB-SCSI-A to return to the Initiator 16 bytes of sense data during the Data In phase.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0x03
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x00
   Byte 4 = 0x10
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIRead(databuffer, 16)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

rsc - Request/Release System Control

Type: Initialization function

Purpose: Use `rsc` if some other device in your GPIB system is System Controller.

Format:

Bit / Byte	7	6	5	4	3	2	1	0
0	Opcode = $D1_H$							
1	Reserved							
2	Reserved							
3	Reserved							Mode
4	Reserved							
5	Reserved							

Remarks: If Mode is 1, the GPIB-SCSI-A configures itself to be the GPIB System Controller. If Mode is 0, the GPIB-SCSI-A does not configure itself as System Controller.

As System Controller, the GPIB-SCSI-A can send the Interface Clear (IFC*) and Remote Enable (REN*) messages to GPIB devices. If some other Controller asserts Interface Clear, the GPIB-SCSI-A cannot respond unless it is not configured as System Controller.

In most applications, the GPIB-SCSI-A is System Controller. In some applications, the GPIB-SCSI-A is never System Controller. In either case, `rsc` is used only if the GPIB-SCSI-A is not going to be System Controller while the program executes. The IEEE 488 standard does not specifically allow schemes in which System Control can pass from one device to another, however, `rsc` can be used in such a scheme.

The GPIB-SCSI-A configures itself to be System Controller at power-on.

rsc (continued)

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Status, and Message In phases.

See Also: *sic* and *sre.*

Examples:

Note: Because the only difference between Examples 1 and 2 is the CDB, only the place where the CDB is created is repeated. Example 2 contains the entire program sequence.

1. Request the GPIB-SCSI-A to release System Control.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xD1
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x00
   Byte 4 = 0x00
   Byte 5 = 0x00
```

rsc (continued)

2. Request the GPIB-SCSI-A to configure itself as System Controller.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xD1
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x01
   Byte 4 = 0x00
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

rsp - Request (Conduct) a Serial Poll

Type: Serial Poll function

Purpose: Use `rsp` if you want to conduct a serial poll to obtain device-specific status information from one or more devices.

Format:

Byte \ Bit	7	6	5	4	3	2	1	0
0	Opcode = $D3_H$							
1	GPIB Primary Address					Reserved		
2	GPIB Secondary Addr. (Opt.)					Mode	Reserved	
3	Reserved							
4	Reserved							
5	Reserved							

Remarks: The argument GPIB Primary Address along with GPIB Secondary Address specifies the address of the device the GPIB-SCSI-A serial polls. To indicate that GPIB Secondary Address contains a valid device address, Mode is set to 1.

`rsp` serial polls the specified device to obtain its status byte. If bit 6 (hex 40 or RQS bit) of a device response is set, its status response is positive – that is, the device is requesting service. The interpretation of each device response, other than the RQS bit, is device specific. For example, the polled device might set a particular bit in the response byte to indicate that it has data to transfer, and another bit to indicate a need for reprogramming. Consult your device documentation for interpretation of the response byte.

If a device does not respond in the timeout period, the GPIB-SCSI-A returns -1 (FF hex) and records the EABO error. The time limit is set to 1/10 sec.

rsp (continued)

The GPIB-SCSI-A returns the serial poll response following the poll in the form of a 1 byte binary number during the Data In phase.

If this is the first function you call that requires GPIB Controller capability, and you have not disabled System Controller capability with `rsc`, the GPIB-SCSI-A sends Interface Clear (IFC*) to make itself Controller-In-Charge (CIC). It also asserts Remote Enable.

If you passed control to some other GPIB device, control must be passed back to you or you must send IFC to make yourself CIC before making this call. Otherwise, the GPIB-SCSI-A aborts the command, issues a CHECK CONDITION status response, and sets the Sense Key to ERROR.

If the 1/10 sec serial poll time limit is exceeded before the device responds, the GPIB-SCSI-A aborts the command, issues a CHECK CONDITION status response, and sets the Sense Key to ERROR.

If Mode is 0 and there is anything in the GPIB Secondary Address, the GPIB-SCSI-A aborts the command, issues a CHECK CONDITION status response, and sets the Sense Key to ILLEGAL REQUEST.

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Data In, Status, and Message In phases.

See Also: *tmo* for timeout information.

rsp (continued)

Example:

Request the GPIB-SCSI-A to execute a serial poll of the device with primary GPIB address of 3. The response is returned during the Data In phase as one byte.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xD3
   Byte 1 = 0x18
   Byte 2 = 0x00
   Byte 3 = 0x00
   Byte 4 = 0x00
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIRead(spresp, 1)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

rsv - Request Service/Set or Change Serial Poll Status Byte

Type: Serial Poll function

Purpose: Use `rsv` if the GPIB-SCSI-A is not the GPIB Controller and you want to request service from the Controller using the Service Request (SRQ) signal. The GPIB-SCSI-A provides the user defined status byte indicated by this command when the Controller serial polls it.

Format:

Bit / Byte	7	6	5	4	3	2	1	0
0	Opcode = $D4_H$							
1	Reserved							
2	Reserved							
3	Serial Poll Response							
4	Reserved							
5	Reserved							

Remarks: The Serial Poll Response represents the value of the new GPIB-SCSI-A serial poll response byte.

The serial poll response byte is the status byte that the GPIB-SCSI-A provides when serial polled by another device that is Controller-In-Charge (CIC). If bit 6 (hex 40 or RQS bit) is also set, the GPIB-SCSI-A additionally requests service by asserting the SRQ* line.

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Status, and Message In phases.

rsv (continued)

Examples:

Note: Because the only difference between Examples 1 and 2 is the CDB, only the place where the CDB is created is repeated. Example 2 contains the entire program sequence.

1. Request the GPIB-SCSI-A to set its serial poll response byte to 6 and assert the GPIB SRQ* signal.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xD4
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x46
   Byte 4 = 0x00
   Byte 5 = 0x00
```

2. Request the GPIB-SCSI-A to clear its serial poll response byte and not assert SRQ*.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xD4
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x00
   Byte 4 = 0x00
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

sic - Send Interface Clear

Type: Specialized Controller function

Purpose: You use `sic` if the initialization, I/O, or bus management functions do not meet the needs of your device, or you want to have more precise control over the GPIB. `sic` makes the GPIB-SCSI-A Controller-In-Charge (CIC) and initializes the GPIB. `sic` is not a function you use frequently because in most cases the first I/O or bus management function you call does this automatically.

Format:

Bit / Byte	7	6	5	4	3	2	1	0
0	Opcode = $D5_H$							
1	Reserved							
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							

Remarks: Interface Clear (IFC*) is sent for 500 µsec. The action of asserting the IFC* line for at least 100 µsec initializes the GPIB and makes the GPIB-SCSI-A CIC. When needed, `sic` is generally used at the beginning of a program to make the GPIB-SCSI-A CIC and is used when a bus fault condition is suspected.

The IFC* signal resets only the GPIB interface functions of bus devices and not the internal device functions. (Device functions are reset with the `clr` programming message.) To determine the effect of these messages, consult your device documentation.

If you have disabled its System Controller capability with the `rsc` function, the GPIB-SCSI-A aborts the command, records the ESAC error, issues a CHECK CONDITION status response, and sets the Sense Key to ERROR.

sic (continued)

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Status, and Message In phases.

See Also: *clr* and Appendix C, *Operation of the GPIB.*

Examples:

Request the GPIB-SCSI-A to become CIC by asserting the GPIB IFC* signal.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xD5
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x00
   Byte 4 = 0x00
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

sre - Set/Clear Remote Enable

Type : Specialized Controller function

Purpose: Use `sre` if the I/O and bus management functions do not meet the needs of your device. `sre` gives you more precise control over the GPIB. Use `sre` to turn the Remote Enable signal on and off. `sre` is not a function you use frequently because in most cases, the first I/O or bus management function you call will automatically set remote enable.

Format:

Bit / Byte	7	6	5	4	3	2	1	0
0	Opcode = $D6_H$							
1	Reserved							
2	Reserved							
3	Reserved							Mode
4	Reserved							
5	Reserved							

Remarks: If Mode is 1, the GPIB-SCSI-A asserts the Remote Enable (REN*) signal. If Mode is 0, the GPIB-SCSI-A unasserts REN*.

Many GPIB devices have a remote program mode and a local program mode. It is usually necessary to place devices in remote mode before programming them from the GPIB. A device enters the remote mode when the REN* line is asserted and the device receives its listen address.

Use `cmd` to send a device its listen address after using `sre`. Use `loc` to return the device to local program mode.

If you call `sre` and the GPIB-SCSI-A is not System Controller, the GPIB-SCSI-A aborts the command, records the ESAC error, issues a CHECK CONDITION status response, and sets the Sense Key to ERROR.

sre (continued)

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Status, and Message In phases.

See Also: *rsc*, *cmd*, and *loc*.

Examples:

Note: Because the only difference between Examples 1 and 2 is the CDB, only the place where the CDB is created is repeated. Example 2 contains the entire program sequence.

1. Request the GPIB-SCSI-A to turn off the REN* signal on the GPIB.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xD6
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x00
   Byte 4 = 0x00
   Byte 5 = 0x00
```

sre (continued)

2. Request the GPIB-SCSI-A to assert the GPIB REN* signal.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xD6
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x01
   Byte 4 = 0x00
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

stat - Return GPIB-SCSI-A Status

Type: General Use function

Purpose: Use `stat` to obtain the status of the GPIB-SCSI-A to see if certain conditions are currently present. `stat` is used most often to see if the previous operation resulted in an error. `stat` is also used to configure the GPIB-SCSI-A for continuous status reporting.

Format:

Bit / Byte	7	6	5	4	3	2	1	0
0	Opcode = $D7_H$							
1	Reserved							
2	Reserved							
3	Reserved							Mode
4	Allocation Length							
5	Reserved							

Remarks: The Allocation Length indicates the number of bytes that the Initiator allocates for returned status information. An Allocation Length of zero indicates that no bytes of status information are transferred. Any other value indicates the maximum number of bytes that are transferred, up to eight. The GPIB-SCSI-A terminates the Data In phase when Allocation Length bytes have transferred or when all available status information has transferred to the Initiator, whichever is less.

Use `stat` frequently in the early stages of your program development when the responses of your device are likely to be unpredictable.

stat (continued)

The status information returned by the GPIB-SCSI-A contains four pieces of information: the GPIB-SCSI-A status, a GPIB error code, a SCSI error code, and a count.

GPIB-SCSI-A status represents a combination of conditions. Internally, status is stored as a 16-bit integer. Each bit in the integer represents a single condition.

A bit value of 1 indicates that the corresponding condition is in effect. A bit value of zero indicates that the condition is not in effect. Because more than one GPIB-SCSI-A condition can exist at a time, more than one bit may be set in status. The highest order bit of status, also called the sign bit, is set when the GPIB-SCSI-A detects either a GPIB error or a SCSI port error. Consequently, if the status is negative, an error condition exists. If the status is positive, no error condition exists.

GPIB error represents a single GPIB error condition present.

SCSI error represents a single SCSI error condition present.

The count is the number of bytes transferred over the GPIB by the last `rd`, `wrt`, `brd`, `bwrt`, or `cmd` function.

The GPIB-SCSI-A responds by sending up to eight bytes to the Initiator during the Data In phase representing the following:

- Byte 1: High byte of GPIB-SCSI-A status
- Byte 2: Low byte of GPIB-SCSI-A status
- Byte 3: GPIB error indicator byte
- Byte 4: SCSI error indicator byte

stat (continued)

- Byte 5: High byte of high word of Count of bytes transferred during a `rd`, `wrt`, `brd`, `bwrt`, or `cmd`.
- Byte 6: Low byte of high word of Count of bytes transferred during a `rd`, `wrt`, `brd`, `bwrt`, or `cmd`.
- Byte 7: High byte of low word of Count of bytes transferred during a `rd`, `wrt`, `brd`, `bwrt`, or `cmd`.
- Byte 8: Low byte of low word of Count of bytes transferred during a `rd`, `wrt`, `brd`, `bwrt`, or `cmd`.

stat (continued)

Table 5-6 contains a list of the GPIB-SCSI-A status conditions along with each condition's numeric value, bit, and a brief description.

Table 5-6. GPIB-SCSI-A Status Conditions

Numeric Value (n)	Status	Description	Bit
-32768	ERR	Error detected	15
16384	TIMO	Timeout	14
8192	END	EOI or EOS detected	13
4096	SRQI	SRQ detected while CIC	12
2048	-	Reserved	11
1024	-	Reserved	10
512	-	Reserved	9
256	CMPL	Operation completed	8
128	LOK	Lockout state	7
64	REM	Remote state	6
32	CIC	Controller-In-Charge	5
16	ATN	Attention asserted	4

(continued)

stat (continued)

Table 5-6. GPIB-SCSI-A Status Conditions (continued)

Numeric Value (n)	Status	Description	Bit
8	TACS	Talker active	3
4	LACS	Listener active	2
2	DTAS	Device trigger state	1
1	DCAS	Device clear state	0

Tables 5-7 and 5-8 contain lists of possible error conditions for the GPIB and SCSI, respectively, along with a numeric value and a brief description of each condition.

Table 5-7. GPIB Error Conditions

Numeric Value (n)	Error	Description
0	NGER	No GPIB error condition to report
1	ECIC	Command requires GPIB-SCSI-A to be CIC
2	ENOL	Write detected no listeners
3	EADR	GPIB-SCSI-A not addressed correctly
4	-	Reserved
5	ESAC	Command requires GPIB-SCSI-A to be System Controller

(continued)

stat (continued)

Table 5-7. GPIB Error Conditions (continued)

Numeric Value (n)	Error	Description
6	EABO	I/O operation aborted
7-10	-	Reserved
11	ECAP	Command attempted to use a disabled capability
12-13	-	Reserved
14	EBUS	Could not send command bytes

Table 5-8. SCSI Error Conditions

Numeric Value (n)	Error	Description
0	NSER	No SCSI error condition to report
1-5	-	Reserved
6	EPAR	SCSI parity error occurred. No steps were taken by the GPIB-SCSI-A, but the data read from the SCSI and given to the GPIB may be corrupt.

A detailed description of the conditions under which each bit in status is set or cleared and the conditions under which each error occurs, can be found in Appendix B, *Status and Message Information.*

stat (continued)

In general, the GPIB-SCSI-A updates the first three status variables at the end of each programming message. It updates the fourth status variable, count, after a `cmd`, `rd`, `brd`, `bwrt`, or `wrt` function. Errors reported correspond to the previous programming message. For example, if you call `wrt` and then `stat`, any errors returned to you correspond to errors in the `wrt` programming message, not `stat`.

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Data In, Status, and Message In phases.

Mode indicates whether or not we want to enable or disable continuous status reporting. When Mode is 1, the status information is sent to the Initiator after every command except for `inq` and `rqsns`.

The continuous status information is sent during the Message In phase as an extended message. This message is sent just before the Status byte is sent. The bytes of the extended message consist of the following :

- Byte 1: 01H : extended message indicator
- Byte 2: 09H : extended message length
- Byte 3: FFH : extended message code
- Bytes 4-11: The eight bytes of status information as defined above.

Note: Even when continuous status reporting is enabled, the `stat` command returns the status information during the Data In phase, not the Message In phase.

See Also: Appendix B, *Status and Message Information,* for additional status information.

stat (continued)

Examples:

1. Request the GPIB-SCSI-A to return to the Initiator all eight bytes of the internal status recorded by the GPIB-SCSI-A.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xD7
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x00
   Byte 4 = 0x08
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIRead(statusinf, 8)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

2. Configure the GPIB-SCSI-A for continuous status reporting. Send the `sic` command, then read the continuous status information returned after its execution.

```
Build SCSI Command Descriptor Block (CDB) for
                    the stat command
   Byte 0 = 0xD7
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x01
   Byte 4 = 0x08
   Byte 5 = 0x00
```

stat (continued)

```
SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIRead(statusinf, 8)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

Build SCSI Command Descriptor Block (CDB) for
                     the sic command
   Byte 0 = 0xD5
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x00
   Byte 4 = 0x00
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

/* Call a routine that will read in the eleven
 * Message In bytes.  */
SCSIExtMesgIn(statusinf, 11)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

tmo - Change or Disable Time Limit

Type: Initialization function

Purpose: Use `tmo` at the beginning of your program to change the time limits in effect on the GPIB-SCSI-A. The time limits prevent the GPIB-SCSI-A from hanging indefinitely when waiting for critical events to occur.

Format:

Bit / Byte	7	6	5	4	3	2	1	0
0	Opcode = $D8_H$							
1	Reserved							
2	Reserved							
3	Mode							
4	Reserved							
5	Reserved							

Remarks: The Mode specifies the I/O time limits in effect for the `cmd`, `bwrt`, `brd`, `rd`, and `wrt` according to Table 5-9.

Table 5-9. Timeout Limit Values

Mnemonic	Value	Minimum Timeout
TNONE	0	disabled
T10µsec	1	10 µsec
T30µsec	2	30 µsec
T100µsec	3	100 µsec

(continues)

tmo (continued)

Table 5-9. Timeout Limit Values (continued)

Mnemonic	Value	Minimum Timeout
T300 µsec	4	300 µsec
T1 msec	5	1 msec
T3 msec	6	3 msec
T10 msec	7	10 msec
T30 msec	8	30 msec
T100 msec	9	100 msec
T300 msec	10	300 msec
T1 sec	11	1 sec
T3 sec	12	3 sec
T10 sec	13	10 sec
T30 sec	14	30 sec
T100 sec	15	100 sec
T300 sec	16	300 sec
T1000 sec	17	1000 sec

tmo (continued)

If the GPIB-SCSI-A cannot complete any of these functions within the period of time set by Mode, it aborts the function and records the EABO error. Bytes that were transferred before the timeout are not affected.

The Mode time limit is also the maximum amount of time the `wait` function waits when you call it with the TIMO bit set in the `wait` mask.

The assignment made by this function remains in effect until you call `tmo` again, call `onl`, or turn off the GPIB-SCSI-A.

If you call `tmo` with Mode greater than decimal 17, the GPIB-SCSI-A aborts the command, issues a CHECK CONDITION status response, and sets the Sense Key to ILLEGAL REQUEST.

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Status, and Message In phases.

See Also: *cmd*, *bwrt*, *brd*, *rd*, *wait*, and *wrt.*

tmo (continued)

Example:

Request the GPIB-SCSI-A to change its I/O time limit to 30 sec.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xD8
   Byte 1 = 0x00
   Byte 2 = 0x00
   Byte 3 = 0x0E
   Byte 4 = 0x00
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

trg - Trigger Specified Device *

Type : Bus Management function

Purpose: Use `trg` to trigger the specified device. Refer to your GPIB device documentation for information on the appropriate time to trigger your device and what effect the trigger has.

Format:

Bit / Byte	7	6	5	4	3	2	1	0
0	Opcode = $D9_H$							
1	GPIB Primary Address					Reserved		
2	GPIB Secondary Addr. (Opt.)					Mode	Reserved	
3	Reserved							
4	Reserved							
5	Reserved							

Remarks: The argument GPIB Primary Address along with GPIB Secondary Address indicates the address of the device that the GPIB-SCSI-A will trigger. To indicate that GPIB Secondary Address contains a valid device address, Mode must be set to 1.

If this is the first function you call that requires GPIB Controller capability, and you have not disabled System Controller capability with `rsc`, the GPIB-SCSI-A sends Interface Clear (IFC*) to make itself Controller-In-Charge (CIC). It also asserts Remote Enable.

If you passed control to some other GPIB device, control must be passed back to you or you must send IFC to make yourself CIC before making this call. Otherwise, the GPIB-SCSI-A aborts the command, issues a CHECK CONDITION status response, and sets the Sense Key to ERROR.

trg (continued)

If Mode is 0 and there is anything in the GPIB Secondary Address, the GPIB-SCSI-A aborts the command, issues a CHECK CONDITION status response, and sets the Sense Key to ILLEGAL REQUEST.

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Status, and Message In phases.

Examples:

Note: Because the only difference between Examples 1 and 2 is the CDB, only the place where the CDB is created is repeated. Example 2 contains the entire program sequence.

1. Request the GPIB-SCSI-A to send the Group Execute Trigger (GET) message to the GPIB device with primary address 2, secondary address 10.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xD9
   Byte 1 = 0x10
   Byte 2 = 0x54
   Byte 3 = 0x00
   Byte 4 = 0x00
   Byte 5 = 0x00
```

trg (continued)

2. Request the GPIB-SCSI-A to send GET to the GPIB device with primary address 20 with no secondary address.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xC2
   Byte 1 = 0xA0
   Byte 2 = 0x00
   Byte 3 = 0x00
   Byte 4 = 0x00
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

wait - Wait for Selected Event

Type: General Use function

Purpose: Use `wait` to monitor selected GPIB events and to delay any further GPIB-SCSI-A activity until any of them occur.

Format:

Bit / Byte	7	6	5	4	3	2	1	0
0	Opcode = DA_H							
1	High Byte of Wait Mask							
2	Low Byte of Wait Mask							
3	Reserved							
4	Reserved							
5	Reserved							

Remarks: The Wait Mask is a 16-bit value that indicates the events to wait for. The value represents a bit mask containing a subset of the same bit assignments as the status word described in the `stat` function. Each bit is set or cleared to wait or not to wait, respectively, for the corresponding event to occur.

The GPIB-SCSI-A supports the SCSI disconnection/reconnection scheme with this command if the steps detailed in the section *Disconnection/Reconnection while Waiting for GPIB Events* in Chapter 4, *Programming in S Mode*, are followed.

After receiving the `wait` programming message, the GPIB-SCSI-A monitors GPIB activity. When any event corresponding to the bits set in Wait Mask occurs, the GPIB-SCSI-A completes the command and updates status information indicating its current status. Completion of the command consists of reconnecting to the Initiator if a disconnection has occurred.

wait (continued)

You can use `wait`, for example, if you want to wait until a device requests service before performing a serial poll. In this case, you send the wait programming message with `mask` set to `4,096` (1000 hex). When the command completes, check the status to see if the SRQI bit is set in the returned status indicators.

To prevent the GPIB-SCSI-A from waiting indefinitely for SRQ* to be asserted, set the SRQI and TIMO bits by setting `mask` to `4096 + 16384` (5000 hex). This causes the `wait` to terminate either on SRQI or TIMO, whichever occurs first.

Table 5-10 lists possible Wait Mask Values.

Table 5-10. Wait Mask Values

Decimal Value	Mnemonic	Description	Hex Value	Bit
—	—	Reserved	—	15
16384	TIMO	Timeout	4000	14
8192	END	EOI or EOS detected	2000	13
4096	SRQISRQ	detected while CIC	1000	12
—	—	Reserved	—	11
—	—	Reserved	—	10
—	—	Reserved	—	9
—	—	Reserved	—	8

(continues)

wait (continued)

Table 5-10. Wait Mask Values (continued)

Decimal Value	Mnemonic	Description	Hex Value	Bit
128	LOK	Lockout state	80	7
64	REM	Remote state	40	6
32	CIC	Controller-In-Charge	20	5
16	ATN	Attention asserted	10	4
8	TACS	Talker active	8	3
4	LACS	Listener active	4	2
2	DTAS	Device trigger state	2	1
1	DCAS	Device clear state	1	0

If mask is 0, the function completes immediately after updating the status.

If the TIMO bit is 0 or the time limit is disabled by using `tmo` with 0 as Mode, timeouts for this function are disabled. You should disable timeouts only when you are certain the selected event will occur. Otherwise, the GPIB-SCSI-A waits indefinitely for the event to occur.

If any bits listed in Table 5-10 as Reserved are set in the Wait Mask, the GPIB-SCSI-A aborts the command, issues a CHECK CONDITION status response, and sets the Sense Key to ILLEGAL REQUEST.

wait (continued)

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Status, and Message In phases.

See Also: `stat`, `tmo`, and the *Disconnection/Reconnection While Waiting for GPIB Events* section in Chapter 4, *Programming in S Mode.*

Examples:

1. Use `wait` without the SCSI disconnection/reconnection capability to wait indefinitely for the GPIB-SCSI-A to become either GPIB listen or talk addressed before continuing.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xDA
   Byte 1 = 0x00
   Byte 2 = 0x0C
   Byte 3 = 0x00
   Byte 4 = 0x00
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

wait (continued)

2. Use `wait` with the SCSI disconnection/reconnection capability to wait for the GPIB-SCSI-A to either timeout or detect the END message along the GPIB (either EOS sent or EOI* signaled).

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xDA
   Byte 1 = 0x60
   Byte 2 = 0x00
   Byte 3 = 0x00
   Byte 4 = 0x00
   Byte 5 = 0x00

SCSIArbitrate

SCSISelectATN(GPIB-SCSI-A id)

SCSIMesgOut(0xc0)

SCSICmd(CDB)

If SCSI phase = Message In
      SCSIMesgIn(Mbyte)
      If Mbyte = SAVE DATA POINTER
               Set up necessary conditions and
               wait to be reconnected by the
               GPIB-SCSI-A.  Upon reconnection,
               the GPIB-SCSI-A enters the
               Message In phase and sends an
               IDENTIFY message of 0x80.

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

wrt - Write Data *

Type: High-level I/O Function

Purpose: Use `wrt` to send data over the GPIB. All GPIB addressing is performed automatically.

Format:

Bit / Byte	7	6	5	4	3	2	1	0
0	Opcode = DB_H							
1	GPIB Primary Address					High 3 bits of Cnt		
2	GPIB Secondary Addr. (Opt.)					Mode	2 bits of Cnt	
3	Middle Byte of Count							
4	Least Significant Byte of Count							
5	Reserved							

Remarks: The argument GPIB Primary Address along with the GPIB Secondary Address indicates the address of the device to which the GPIB-SCSI-A attempts to write data. To indicate that GPIB Secondary Address contains a valid device address, set Mode to 1. Count is a 21-bit unsigned count that represents the number of bytes to write. Therefore, Count can represent a number between 0 and 2,097,152.

All data received from the SCSI Initiator during the Data Out phase is passed to the GPIB Listeners. If an error occurs with the GPIB, the GPIB-SCSI-A stops attempting to transfer data from the SCSI to the GPIB. Instead, the GPIB-SCSI-A finalizes processing of the command according to Switch 5 of configuration switch SW2. If Switch 5 is OFF, the GPIB-SCSI-A reads all the data from the SCSI Initiator until the count requested is exhausted. If Switch 5 is ON, the GPIB-SCSI-A immediately changes to the Status phase without transferring additional data.

wrt (continued)

The `wrt` operation terminates when one of the following events occurs:

- The GPIB-SCSI-A successfully transfers all data.
- The GPIB-SCSI-A detects an error.
- The I/O time limit is exceeded.
- Device Clear (DCL) or Selected Device Clear (SDC) command is received from another device that is Controller-In-Charge (CIC).

After `wrt` terminates, the GPIB-SCSI-A records the number of data bytes it actually wrote to the GPIB. If one of the events described above occurs (except if the GPIB-SCSI-A successfully transfers all data), the count may be less than expected.

If the GPIB-SCSI-A is CIC, `wrt` causes the GPIB-SCSI-A to address itself to talk if it is not already addressed. The GPIB-SCSI-A also addresses the device indicated by the Address values in the CDB to listen.

The GPIB-SCSI-A then places itself in Standby Controller state with ATN* off and remains there after the write operation is complete.

The GPIB-SCSI-A must be CIC to perform the addressing.

If this is the first function you call that requires GPIB controller capability and you have not disabled System Controller capability with `rsc`, the GPIB-SCSI-A sends Interface Clear (IFC*) to make itself CIC. It also asserts Remote Enable.

The only possible errors are EABO (if the I/O time limit is exceeded), ECIC (if you passed control to some other GPIB device and control has not been returned to you or you have not sent IFC to make yourself CIC before making this call),

wrt (continued)

EBUS (if the command bytes used for addressing cannot be sent out), or ENOL (if there are no addressed Listeners when the GPIB-SCSI-A begins to write data). If an error occurs, the GPIB-SCSI-A aborts the command, issues a CHECK CONDITION status response, and sets the Sense Key to ERROR.

If Mode is 0 and there is anything in the GPIB Secondary Address, the GPIB-SCSI-A aborts the command, issues a CHECK CONDITION status response, and sets the Sense Key to ILLEGAL REQUEST.

The information transfer phases that the GPIB-SCSI-A drives the SCSI through after selection are the Command, Data Out, Status, and Message In phases.

See Also: `eos`, `eot`, and `tmo` for timeout information.

wrt (continued)

Examples:

1. Use `wrt` without the SCSI disconnection/reconnection capability to write 50 bytes of data to the GPIB device at primary address 9 and secondary address 1.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xDB
   Byte 1 = 0x48
   Byte 2 = 0x0C
   Byte 3 = 0x00
   Byte 4 = 0x32
   Byte 5 = 0x00

SCSIArbitrate

SCSISelect(GPIB-SCSI-A id)

SCSICmd(CDB)

SCSIWrite(databuffer, 50)

SCSIStatus(Sbyte)

SCSIMesgIn(Mbyte)

ErrorCheck
```

wrt (continued)

2. Use `wrt` with the SCSI disconnection/reconnection capability to write 1,500 bytes of data to the GPIB device at primary address 2 with no secondary address.

```
Build SCSI Command Descriptor Block (CDB)
   Byte 0 = 0xDB
   Byte 1 = 0x10
   Byte 2 = 0x00
   Byte 3 = 0x05
   Byte 4 = 0xDC
   Byte 5 = 0x00

SCSIArbitrate

SCSISelectATN(GPIB-SCSI-A id)

SCSIMesgOut(0xc0)

SCSICmd(CDB)

While Not Done
   While SCSI phase = Data Out
         SCSIWrite(buffer, 1)
         Increment buffer pointer
   If SCSI phase = Message In
         SCSIMesgIn(Mbyte)
         If Mbyte = SAVE DATA POINTER
               Set up necessary conditions and
               wait to be reconnected by the
               GPIB-SCSI-A.  Upon reconnection,
               the GPIB-SCSI-A enters the
               Message In phase and sends an
               IDENTIFY message of 0x80.  The
               Data Out phase should resume.
```

wrt (continued)

```
      If SCSI Phase = Status
            SCSIStatus(Sbyte)
            SCSIMesgIn(Mbyte)
            Done

    /* In the outer While loop, wait until you are
     *  sure that the GPIB-SCSI-A has finished the
     *  command.  The only time you can be sure
     *  about this is after the final Status and
     *  Message In phases–that is why Done is set
     *  in the Status phase condition.  Also, the
     *  only phase that can normally follow the
     *  Status phase is the Message In phase.  If
     *  the phase is Message In not following a
     *  Status phase, the GPIB-SCSI-A is either
     *  notifying the Initiator that it is going to
     *  disconnect from the SCSI or after
     *  reconnection, is sending the IDENTIFY
     *  message.  As long as the phase is the Data
     *  Out phase, the GPIB-SCSI-A is receiving
     *  data bytes from the SCSI to send to the
     *  GPIB.  The byte count specified in the CDB
     *  should be sent.
     */

   ErrorCheck
```

Chapter 6
Programming in G Mode

This chapter explains how to program the GPIB-SCSI-A when operating in G mode. It describes programming messages, their format, and how they are processed, along with the functions and function arguments that make up the programming messages. This chapter also explains how to communicate with your SCSI device(s) through the GPIB-SCSI-A.

Note: This chapter presumes some basic knowledge of the SCSI operation. For basic information about the SCSI, refer to Appendix D, *Operation of the SCSI.*

Programming Messages

You program the GPIB-SCSI-A by sending it programming messages (which are ASCII strings) by way of its GPIB port.

Programming Message Format

The programming message format consists of a function name, one or more arguments (which may or may not be optional), followed by a carriage return (<CR>), a linefeed (<LF>), or both a linefeed and a carriage return (<LF><CR>).

Example of a Programming Message

In the following lines of code, the GPIB-SCSI-A is commanded to return its system identification to the Command and Status Channel's buffer. The code then retrieves this information and displays it on the computer.

Note: This example uses the National Instruments NI-488 functions for an Apple Macintosh computer using THINK C.

```
      char *wrtbuf, *rdbuf;
      int gpibscsia;

      if (gpibscsia = ibfind("gpibscsia"))

/* Open GPIB communications with the
 * Command and Status Channel
 */

      {
         printf("gpibscsia not found.\n");
         ExitToShell();
      }
      rdbuf = calloc (200, 1);
      wrtbuf = calloc (15,1)

/* Allocate memory for the buffers.  This call
 * also clears the memory to nulls.
 */

      if ((rdbuf == NULL) || (wrtbuf == NULL))

/* Make sure that the buffers were allocated. */
      {
         printf("Out of memory.\n");
         ExitToShell();
      }
      strcpy (wrtbuf, "id\n");

/* Assign a programming message to the string
 * buffer.  The '\n' will put an <LF> at the end
 * of the command.
 */

      ibwrt (gpibscsia, wrtbuf, 3);

/* Command the GPIB-SCSI-A to report system
 * identification.
 */

      ibrd  (gpibscsia, rdbuf, 1000);
```

```
/*  Read in the system identification of the GPIB-
 *  SCSI-A.  The GPIB read is performed with a
 *  count of 1000 because the byte count returned
 *  may not be known.  The GPIB-SCSI-A signals an
 *  END condition on GPIB writes for the last byte
 *  in the Command and Status Channel buffer.
 */

      printf(" response:  %s\n", rdbuf)

/* Because calloc clears the memory we allocated,
 * and the GPIB-SCSI-A does not have a null byte
 * in the system identification, we can use the
 * C printing of a string until a null character
 * to print the response.
 */
```

Note: You can enter programming messages to the GPIB-SCSI-A in any combination of uppercase and lowercase letters.

How Messages are Processed

The GPIB-SCSI-A processes each programming message separately on a line-by-line basis. The GPIB-SCSI-A buffers the entire message, interprets the function name and arguments, then executes the message.

Function Names

The function names have been selected to indicate the purpose of each function, thereby making your programs easy to understand. However, if you wish to reduce some overhead in your program, use only as much of the function name as is necessary to distinguish it from other functions. This abbreviated form of the function name is shown in **boldface** in the function tables later in this chapter and in the syntax portions of the function descriptions contained in Chapter 7, *G Mode Functions.*

Function Argument Delimiters

When specifying a function, separate the first argument from the function name with at least one space. Separate each additional argument with at least one space or comma.

In the syntax portions of the function descriptions in Chapter 7, *G Mode Functions,* the square brackets ([ ]) that enclose some arguments indicate that those arguments are optional. Do not enter the brackets as part of your argument.

Numerical Input and Output

The GPIB-SCSI-A has variable numeric argument formats. In the programming messages, numeric arguments can be specified in decimal (base 10), binary (base 2), octal (base 8), or hexadecimal (base 16). To indicate one of these bases, you must attach one of the following prefixes to the number:

- decimal — To indicate decimal numbers, just enter the number without a prefix.
- binary — To indicate a binary number, precede the number with a #b or #B prefix. For example, #b11011001 represents the byte value of D9 hex, or 217 decimal.
- octal — To indicate an octal number, precede the number with a #q or #Q prefix. For example, #Q153 represents the byte value of 6B hex, or decimal 107.
- hexadecimal — To indicate a hexadecimal number, precede the number with a #h or #H prefix. For example, #h45 represents the byte value of 45 hex, or decimal 69.

Unless otherwise indicated, when you are asked for a numerical value, you can supply the value in any of the above mentioned ways.

Although the GPIB-SCSI-A accepts numerical values in any of the previous four formats, all the responses generated by the GPIB-SCSI-A are in decimal.

Status and Error Information

The function descriptions in Chapter 7, *G Mode Functions*, explain that the GPIB-SCSI-A *records* specific status and error information. This means that it stores that information in its memory so that when you request it it is available.

The function descriptions also explain that the GPIB-SCSI-A *returns to you* certain information. This means that the GPIB-SCSI-A sends information to you over the GPIB when requested. You then interpret this status in your application. This information is returned either separately in response to the issuing of the `stat` command or continuously if specified by the `C` flag in the `stat` command. In the event of an error, the GPIB-SCSI-A may or may not complete the command to its fullest extent, depending on the error. For more information about G mode error indications, refer to the description of `stat` in Chapter 7, *G Mode Functions*, as well as Appendix B, *Status and Message Information*.

Communicating with the GPIB-SCSI-A and SCSI Peripherals

The GPIB-SCSI-A uses two channels for data processing. These channels are referred to as the *Command and Status Channel* and the *Data Channel*. The GPIB-SCSI-A differentiates between the data depending on which channel is addressed.

There are two different ways to address the channels. The types of addressing are user selectable between *Major/Minor GPIB addressing* and *secondary GPIB addressing* by setting Switch 5 of SW2. For a more detailed description of the two types of addressing, refer to the *Switch 5* section in Chapter 3, *Technical Information*.

Addressing Terminology

When the GPIB-SCSI-A receives the Data Channel address, the data it sends and receives is referred to as SCSI data.

When the GPIB-SCSI-A receives its own address, that of the Command and Status Channel, the data it receives is referred to as programming messages. The data it sends is referred to as status or message information.

The GPIB-SCSI-A and SCSI System as Listener

When the GPIB-SCSI-A receives the Command and Status Channel listen address, it examines the data received over the GPIB (treating it as a programming message or messages) and responds accordingly.
When the GPIB-SCSI-A receives the Data Channel listen address, it forwards the data received over the GPIB to the SCSI port during the Data Out phase without examining the data.

Because the GPIB-SCSI-A can communicate with any SCSI device in the SCSI system of which the GPIB-SCSI-A is a part, one of the first requirements is that you indicate to the GPIB-SCSI-A the SCSI ID of the Target device with which you want to communicate by using **`tid`**. After using **`tid`**, any other request made to the GPIB-SCSI-A that causes communication with the SCSI system is made to the device with a SCSI Target ID set by **`tid`**.

For example, if you have a SCSI disk drive that responds to a SCSI Target ID of 4 connected to the GPIB-SCSI-A and you want to send data from your computer over the GPIB to be stored on the disk drive, you must complete the following steps:

1. Use **`tid`** `4` to indicate to the GPIB-SCSI-A that future communication with the SCSI system is made to the device with Target ID 4.

2. Send the **`write`** command to indicate to the GPIB-SCSI-A that you want to send data from the GPIB to the SCSI device at Target ID 4. This is analogous to making the SCSI device at Target ID 4 a GPIB Listener.

Once you have completed steps 1 and 2, the GPIB-SCSI-A performs the following:

1. The GPIB-SCSI-A automatically handles the arbitration for the SCSI bus, the selection of the disk drive at Target ID 4, and waits for data from the Data Channel. Any of this data is sent directly to the SCSI device.

2. When all of the data has been sent, the GPIB-SCSI-A automatically handles the final Status and Message In phases that the disk drive creates to complete the transfer.

3. The information bytes received from the Status and Message In phases are stored in a buffer in the GPIB-SCSI-A and can be retrieved by reading GPIB data from the Command and Status Channel.

The LISTEN LED on the GPIB-SCSI-A front panel is lit when the GPIB-SCSI-A is addressed to listen.

The GPIB-SCSI-A and SCSI System as Talker

When the GPIB-SCSI-A receives the Command and Status Channel talk address, it sends out status information that has been buffered. This can be either the SCSI Status phase and Message In phase information or, if you have enabled status reporting with the `stat` command, the internal status of the GPIB-SCSI-A.

When the GPIB-SCSI-A receives the Data Channel talk address, it sends all data received from the SCSI during the Data In phase to the GPIB.

Because the GPIB-SCSI-A can communicate with any SCSI device in the SCSI system of which the GPIB-SCSI-A is a part, one of the first requirements is that you indicate to the GPIB-SCSI-A the Target ID of the SCSI device with which you want to communicate by using **`tid`**. After using **`tid`**, any other request made to the GPIB-SCSI-A that causes communication with the SCSI system is made to the device with a SCSI Target ID set by **`tid`**.

For example, if you have a SCSI disk drive that responds to a SCSI Target ID of 4 connected to the GPIB-SCSI-A and you want to receive data from the disk drive into your computer through the GPIB, you must complete the following steps:

1. Use **`tid 4`** to indicate to the GPIB-SCSI-A that future communication with the SCSI system is made with the device at Target ID 4.

2. Send the **`read`** command to indicate to the GPIB-SCSI-A that you want to receive data from the SCSI device at Target ID 4. This is analogous to making the SCSI device at Target ID 4 a GPIB Talker.

Once you have completed steps 1 and 2, the GPIB-SCSI-A performs the following:

1. The GPIB-SCSI-A automatically handles the arbitration for the SCSI bus, the selection of the disk drive at Target ID 4, and waits for the Data Channel to become talk addressed by the GPIB Controller before passing data from the disk drive to the GPIB.

2. When all of the data has been sent, the GPIB-SCSI-A automatically handles the final Status and Message In phases that the disk drive creates to complete the transfer.

3. The information bytes received from the Status and Message In phases are stored in a buffer in the GPIB-SCSI-A and can be retrieved by reading GPIB data from the Command and Status Channel.

If the GPIB-SCSI-A receives the Command and Status Channel talk address but has nothing to send, it responds to GPIB reads with a carriage return and a linefeed, accompanied by END.

The TALK LED on the GPIB-SCSI-A front panel is lit when the GPIB-SCSI-A is addressed to talk.

GPIB Read and Write Termination (END and EOS)

The IEEE 488 specification defines two methods GPIB Talkers and Listeners can use to identify the last byte of data messages—END and EOS. The two methods permit a Talker to send data messages of any length without the Listener(s) knowing in advance the number of bytes in the transmission.

END message — The Talker asserts the End Or Identify (EOI*) signal while the last data byte is transmitted. The Listener stops reading when it detects a data message accompanied by EOI*, regardless of the value of the byte.

EOS character — The Talker sends an End Of String (EOS) character at the end of its data string. The Listener stops receiving data when it detects the EOS character. Either a 7-bit ASCII character or a full 8-bit binary byte can be used.

You can use the two methods individually or in combination. It is important that the Listener be configured to detect the end of a transmission.

When the GPIB-SCSI-A receives the Command and Status Channel talk or listen address, no EOS modes are in effect. When talking, the GPIB-SCSI-A asserts EOI* with the last byte of its response.

When the GPIB-SCSI-A receives the Data Channel talk address, the GPIB-SCSI-A automatically asserts EOI* on the last byte of data to be transferred from the SCSI to the GPIB. When the GPIB-SCSI-A receives the Data Channel listen address, the GPIB-SCSI-A responds to receiving the END signal from the Talker by stopping the transmission of data received from the GPIB to the SCSI and starting the sending of a pad byte to fill the requested count of data transfer. The choice of pad byte is user-configurable through the **pad** command.

SCSI Data Transmission

The GPIB-SCSI-A optionally checks the data received from the SCSI system for parity errors. If a SCSI port error occurs, the GPIB-SCSI-A records the appropriate error code in its status area. To determine if a SCSI error has occurred, use **stat** to request GPIB-SCSI-A status information. After the SCSI error code has been reported, the error indication is reset automatically so that no further action to the GPIB-SCSI-A is necessary.

The SCSI Message System and the GPIB-SCSI-A

Operating as an Initiator in G mode, the GPIB-SCSI-A automatically sends only the IDENTIFY message which is necessary for the disconnection/ reconnection operation. Any other message sent during a G mode operation must be specified within a low-level command sequence using the `msgout` command, which is detailed in Chapter 7, *G Mode Functions*.

Messages coming from the Target to the GPIB-SCSI-A are buffered into the buffer of the Command and Status Channel. The only time the GPIB-SCSI-A automatically receives Message bytes from the Target is during disconnection/reconnection attempts and at the final Message In phase following the Status phase. If the Target device requires any other messages, low-level command sequences using `msgin` must be used.

Handling of SCSI Phases in G Mode

When the GPIB-SCSI-A issues one of the high-level SCSI commands, it expects the SCSI phases to follow a prescribed sequence. An EPHS error indication results if these phases do not occur as expected.

If your SCSI device does not follow the sequence of phases specified below, you must use the low-level commands provided.

Commands That Do Not Require a Data Phase

If the command does not require a data phase, the Target completes the following phase sequence after Selection:

1. The Message Out phase if the Target responds to the SCSI ATN* signal. The message that the GPIB-SCSI-A sends to the Target is an IDENTIFY message. This IDENTIFY contains the Logical Unit Number set with the `lun` command. IDENTIFY also contains the bit that indicates that the GPIB-SCSI-A supports the disconnection/reconnection feature of the SCSI. This phase is optional, but if it does not occur, disconnection/reconnection is not possible.

2. The Command phase

3. The Status phase. Disconnection/reconnection is possible before this phase occurs.

4. The Message In phase

Commands That Require a Data In Phase

If the command requires a Data In phase, the Target completes the following phase sequence after Selection:

1. The Message Out phase if the Target responds to the SCSI ATN* signal. The message that the GPIB-SCSI-A sends to the Target is an IDENTIFY message. This IDENTIFY contains the Logical Unit Number set with the `lun` command. IDENTIFY also contains the bit that indicates that the GPIB-SCSI-A supports the disconnection/ reconnection feature of the SCSI. This phase is optional, but if it does not occur, disconnection/reconnection is not possible.

2. The Command phase

3. The Data In phase. The Target may disconnect/reconnect.

4. The Status phase

5. The Message In phase

Commands That Require a Data Out Phase

If the command requires a Data Out phase, the Target completes the following phase sequence after Selection:

1. The Message Out phase if the Target responds to the SCSI ATN* signal. The message that the GPIB-SCSI-A sends to the Target is an IDENTIFY message. This IDENTIFY contains the Logical Unit Number set with the `lun` command. IDENTIFY also contains the bit that indicates that the GPIB-SCSI-A supports the disconnection/reconnection feature of the SCSI. This phase is optional, but if it does not occur, disconnection/reconnection is not possible.

2. The Command phase

3. The Data Out phase. The Target may disconnect/reconnect.

4. The Status phase

5. The Message In phase

Disconnection/Reconnection

The Target can disconnect from the SCSI bus between the Command and Status phases to complete a time-consuming task. When finished, the Target reconnects. However, this is only possible if the GPIB-SCSI-A is able to send the IDENTIFY message to the Target during the Message Out phase.

If the disconnection/reconnection occurs before data transfer has completed, the data phase should assert after reconnection. If it does not, the EPHS error indication results.

If the Target attempts a disconnection/reconnection, the Target completes the following phase sequence:

1. The Message In phase (to alert the GPIB-SCSI-A that the Target is about to disconnect from the SCSI by releasing BSY*). All messages received are placed into the Command and Status Channel buffer.

2. The Bus Free phase (by releasing BSY*)

3. The Reselection phase (when reconnection to the GPIB-SCSI-A is desired)

4. The Message In phase (to allow the SCSI device to send the IDENTIFY message). All messages received are placed into the Command and Status Channel buffer.

G Mode Default Settings

The GPIB-SCSI-A defaults to never asserting SRQ. Use the **srqen** command to configure the GPIB-SCSI-A to assert SRQ under certain conditions. Refer to **srqen** in Chapter 7, *G Mode Functions*, for an explanation of these conditions.

G Mode Functions

The GPIB-SCSI-A G mode functions are divided into four groups–SCSI functions, SCSI Configuration functions, GPIB Configuration functions, and General Use functions.

The following G mode function tables contain the programming messages that are sent to the GPIB-SCSI-A from a GPIB Talker to configure the GPIB-SCSI-A.

Note: Boldface letters contained within each function indicate the abbreviated form that you can use for that function.

SCSI Function Group

Table 6-1 lists the SCSI functions along with a short description of each.

Table 6-1. SCSI Functions

Function	Description
cmd	Create a Command Descriptor Block containing bytes specified following **cmd**.
cmp	Performs a the low-level operation to finish the SCSI command by getting the Status and Message In bytes from the SCSI device.
dtin	Low-level command to set up the GPIB-SCSI-A to accept SCSI data.
dtout	Low-level command to set up the GPIB-SCSI-A to send data.
format	Issue the high-level FORMAT command to the specified Target.
getscsi	Perform the low-level command to arbitrate for the SCSI bus.
hcmd	Issue a high-level command to the specified Target using the command bytes following **h**cmd.
inquiry	Issue the high-level INQUIRY command to the specified Target.
mdsct	Issue the high-level MODE SELECT command to the specified Target.

(continues)

Table 6-1. SCSI Functions (continued)

Function	Description
mdsns	Issue the high-level MODE SENSE command to the specified Target.
msgin	Performs the low-level command to get Message In data to the GPIB-SCSI-A from the selected SCSI Target.
msgout	Performs the low-level command to send message bytes to the selected Target during the Message Out phase.
rblks	Issue the high-level REASSIGN BLOCKS command to the specified Target.
rcdia	Issue the high-level RECEIVE DIAGNOSTICS command to the specified Target.
rcnct	Routine to set up the GPIB-SCSI-A for reconnection to a disconnected Target.
rdbuf	Issue the high-level READ BUFFER command to the specified Target.
rdcap	Issue the high-level READ CAPACITY command to the specified Target.
rdext	Issue high-level Group 1 READ EXTENDED command to the specified Target.
rdfct	Issue the high-level READ DEFECT command to the specified Target.

(continues)

Table 6-1. SCSI Functions (continued)

Function	Description
read	Issue the high-level Group 0 READ command to the specified Target.
rewind	Issue the high-level REWIND command to the specified Target.
rlseu	Issue the high-level RELEASE UNIT command to release any reservations in the specified Target that were created by RESERVE UNIT.
rqsns	Issue the high-level REQUEST SENSE command to the specified Target.
rsrvu	Issue the high-level RESERVE UNIT command to reserve operations in the specified Target for the GPIB-SCSI-A.
rst	Asserts the SCSI RST* line for approximately 100 µsec. The assertion of this line for 25 µsec should indicate a valid reset condition.
selwa	Select the Target specified by the **ti**d command with SCSI ATN* line asserted.
selwo	Select the Target specified by the **ti**d command without the SCSI ATN* line asserted.
sndia	Issue the high-level SEND DIAGNOSTIC command to the specified Target.

(continues)

Table 6-1. SCSI Functions (continued)

Function	Description
space	Issue the high-level SPACE command to the specified Target.
tstur	Issue the high-level TEST UNIT READY command to the specified Target.
wfmks	Issue the high-level WRITE FILEMARKS command to the specified Target.
wrext	Issue the high-level Group 1 WRITE EXTENDED command to the specified Target.
write	Issue the high-level Group 0 WRITE command to the specified Target.
wrtbuf	Issue the high-level WRITE BUFFER command to the specified Target.

SCSI Configuration Function Group

Table 6-2 lists the SCSI Configuration functions along with a short description of each.

Table 6-2. SCSI Configuration Functions

Function	Description
autotst	Configure the GPIB-SCSI-A to automatically test a list of Targets when it is idle.
blksz	Select the Block Size of the Target. This value is used internally to give the GPIB- SCSI-A some knowledge of data amounts.
lun	Select the Logical Unit Number that will be placed in the high-level calls Command Descriptor Block.
pad	Specify a padding byte that the GPIB-SCSI-A will append to any data going from the GPIB-SCSI-A to a SCSI device after the GPIB-SCSI-A has received END or an error has occurred.
tid	Specify a SCSI Target ID that will be used during high-level calls for selection purposes.
vcb	Select the bits of the Vendor Unique Control byte that will be placed in the high-level calls Command Descriptor Block.

GPIB Configuration Function Group

Table 6-3 lists the GPIB Configuration function along with a short description.

Table 6-3. GPIB Configuration Function

Function	Description
srqen	Set conditions for asserting SRQ

General Use Function Group

Table 6-4 lists the General Use functions along with a short description of each.

Table 6-4. General Use Functions

Function	Description
config	Read or change GPIB-SCSI-A configuration.
id	Identify the GPIB-SCSI-A.
stat	Select the type of status reporting desired from the GPIB-SCSI-A, or request the status.

List of G Mode Functions in Alphabetical Order

Table 6-5 is an alphabetical list of all G mode functions.

Table 6-5. GPIB-SCSI-A G Mode Functions

Function	Description
autotst	Configure the GPIB-SCSI-A to automatically test a list of Targets when it is idle.
blksz	Select the Block Size of the Target that will be used internally to the GPIB-SCSI-A during data transfers.
cmd	Create a Command Descriptor Block containing command bytes specified following **cmd**.
cmp	Performs the low-level operation to finish the SCSI command by getting the Status and Message In bytes from the SCSI device.
config	Read or change GPIB-SCSI-A configuration.
dtin	Low-level command to set up the GPIB-SCSI-A to accept SCSI data.
dtout	Low-level command to set up the GPIB-SCSI-A to send data.
format	Issue the high-level FORMAT command to the specified Target.

(continues)

Table 6-5. GPIB-SCSI-A G Mode Functions (continued)

Function	Description
getscsi	Perform the low-level command to arbitrate for the SCSI bus.
hcmd	Issue a high-level command to the specified Target using the command bytes following **h**cmd.
id	Identify the GPIB-SCSI-A.
inquiry	Issue the high-level INQUIRY command to the specified Target.
lun	Select the Logical Unit Number that will be placed in the high-level calls Command Descriptor Block.
mdsct	Issue the high-level MODE SELECT command to the specified Target.
mdsns	Issue the high-level MODE SENSE command to the specified Target.
msgin	Performs the low-level command to get Message In data to the GPIB-SCSI-A from the selected SCSI Target.
msgout	Performs the low-level command to send message bytes to the selected Target during the Message Out phase.
pad	Specify a padding byte. The GPIB-SCSI-A appends this byte to any data going from the GPIB-SCSI-A to a SCSI device after the GPIB-SCSI-A receives END or detects an error.

(continues)

Table 6-5. GPIB-SCSI-A G Mode Functions (continued)

Function	Description
rblks	Issue the high-level REASSIGN BLOCKS command to the specified Target.
rcdia	Issue the high-level RECEIVE DIAGNOSTICS command to the specified Target.
rcnct	Routine to set up the GPIB-SCSI-A for reconnection to a disconnected Target.
rdbuf	Issue the high-level READ BUFFER command to the specified Target.
rdcap	Issue the high-level READ CAPACITY command to the specified Target.
rdext	Issue high-level Group 1 READ EXTENDED command to the specified Target.
rdfct	Issue the high-level READ DEFECT command to the specified Target.
read	Issue the high-level Group 0 READ command to the specified Target.
rewind	Issue the high-level REWIND command to the specified Target.
rlseu	Issue the high-level RELEASE UNIT command to release any reservations in the specified Target that were created by **rs**rvu.

(continues)

Table 6-5. GPIB-SCSI-A G Mode Functions (continued)

Function	Description
rqsns	Issue the high-level REQUEST SENSE command to the specified Target.
rsrvu	Issue the high-level RESERVE UNIT command to reserve operations in the specified Target for the GPIB-SCSI-A.
rst	Asserts the SCSI RST* line for approximately 100 µsec. The assertion of this line for 25 µsec should indicate a valid reset condition.
selwa	Select the Target specified by the **ti**d command with SCSI ATN* line asserted.
selwo	Select the Target specified by the **ti**d command without the SCSI ATN* line asserted.
sndia	Issue the high-level SEND DIAGNOSTIC command to the specified Target.
space	Issue the high-level SPACE command to the specified Target.
srqen	Set conditions for asserting SRQ.
stat	Select the type of status reporting desired from the GPIB-SCSI-A, or request the status.
tid	Specify a SCSI Target ID that will be used during high-level calls for selection purposes.

(continues)

Table 6-5. GPIB-SCSI-A G Mode Functions (continued)

Function	Description
tstur	Issue the high-level TEST UNIT READY command to the specified Target.
vcb	Select the Vendor Unique Control byte bits that will be placed in the High Level calls' Command Descriptor Block.
wfmks	Issue the high-level WRITE FILEMARKS command to the specified Target.
wrext	Issue the high-level Group 1 WRITE EXTENDED command to the specified Target.
write	Issue the high-level Group 0 WRITE command to the specified Target.
wrtbuf	Issue the high-level WRITE BUFFER command to the specified Target.

Operation of the GPIB-SCSI-A as a GPIB Device

In G Mode, a GPIB-SCSI-A device operates like other GPIB devices. As a result, GPIB-SCSI-A device is configured to respond in a variety of ways to GPIB commands. The following are methods by which GPIB-SCSI-A responds to GPIB commands.

Serial Poll

The GPIB-SCSI-A can return status information to the GPIB Controller through the serial poll response byte. The GPIB-SCSI-A maintains this response byte throughout operation, regardless of the **srqen** configuration. The GPIB-SCSI-A can provide certain status information when it is serial polled. This byte contains eight bits of information as detailed in Figure 6-1.

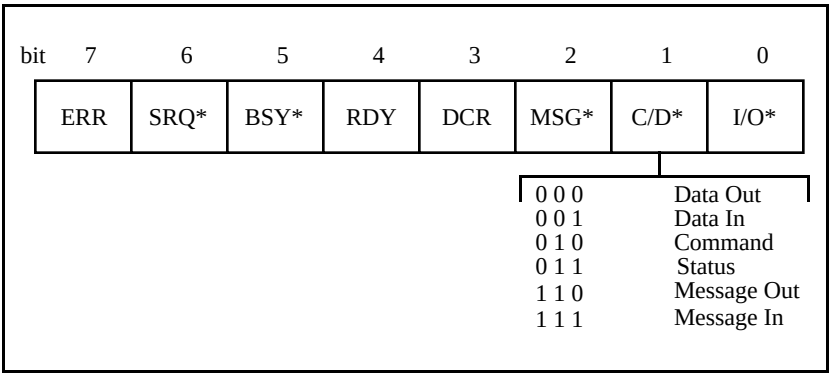

Figure 6-1. Serial Poll Status Byte

SCSI Bits

BSY*, MSG*, C/D*, and I/O* are SCSI signal indicators. MSG*, C/D*, and I/O* indicate the current information transfer phase for the SCSI bus. BSY* indicates that the SCSI bus is currently in use. MSG*, C/D*, and I/O* are valid only if BSY* is active. For more information on the purpose of these SCSI signals, refer to Appendix D, *Operation of the SCSI*.

DCR Bit

DCR indicates Data Channel ready. This bit is set when the Data Channel initially becomes ready for information transfer. For GPIB writes of data to a SCSI Target, this bit is set when the Target enters the Data Out phase. For GPIB reads of data from a SCSI Target, this bit is set when the Target enters the Data In phase.

It is possible for DCR to not be set as expected. This occurs if the command string issued to the GPIB-SCSI-A causes a command descriptor block to be issued which is not accepted by the SCSI Target. In this case, the Target will not go into a data transfer phase, but will go directly into the Status and Message In phases to indicate the error.

RDY Bit

RDY indicates that the GPIB-SCSI-A is ready to process another command.

It is possible to have RDY set and not have performed the desired task. RDY occurs by issuing an errored command string. RDY can also occur when a SCSI device fails to complete the normal phase sequence described in the section titled *Handling of SCSI Phases in G Mode* discussed earlier in this chapter.

Anytime you are relying on DCR to proceed with your application, you should also monitor RDY.

ERR Bit

ERR indicates that an error occurred in the GPIB-SCSI-A. The same events that set the ERR bit in the status word also set the ERR bit in the serial poll status byte. For information about the events that cause the ERR to be set in the status word, refer to *stat* in Chapter 7, *G Mode Functions.*

SRQ* Bit

SRQ* indicates whether or not the GPIB-SCSI-A is asserting the SRQ* signal to alert the Controller of some condition.

The GPIB-SCSI-A can be configured with the **srqen** function to assert the SRQ* signal in the event of ERR, RDY, or DCR. Refer to the *srqen* function description in Chapter 7, *G Mode Functions,* for information on how to configure the GPIB-SCSI-A to assert SRQ* on specific conditions.

Parallel Poll

The GPIB-SCSI-A sets its ist (individual status) bit whenever it asserts SRQ*, and clears ist whenever it unasserts SRQ*. In G mode, the GPIB-SCSI-A implements IEEE 488 Parallel Poll (PP) interface function subset PP1. This means that it cannot configure itself to respond to parallel polls. It must be configured remotely by an external controller.

Group Execute Trigger (GET)

This has no effect on the GPIB-SCSI-A.

Go To Local (GTL)

This has no effect on the GPIB-SCSI-A.

Take Control (TCT)

This has no effect on the GPIB-SCSI-A. It does not make sense for the GPIB-SCSI-A to be passed control, since all programming instructions must be sent to it from another GPIB device.

Device Clear

A device clear occurs when the GPIB-SCSI-A receives the universal Device Clear (DCL) command, or when it receives its listen address and the Selected Device Clear (SDC) command. If a G mode function is currently executing, it is aborted. The Command and Status Channel buffer is emptied, and the GPIB-SCSI-A prepares to receive the next programming message.

Use DCL or SDC if the GPIB-SCSI-A is not accepting commands from the Command and Status Channel as it should be. After using these commands, you can use the `stat` command to help determine any problems. If you find that the SCSI bus is "hung", use the `rst` command to create a RESET condition on the SCSI bus.

Chapter 7
G Mode Functions

This chapter contains a detailed description of each G mode function. The functions are in alphabetical order for easy reference and each function contains its syntax and purpose, as well as some examples.

Points to Remember

Consider the following points when reading through the G mode functions:

- In the function syntax descriptions, arguments shown in square brackets ([]) are optional. Do not enter the brackets as part of your argument.

- Terminate each programming message with a carriage return (<CR>), a linefeed (<LF>), a carriage return followed by a linefeed (<CR><LF>), or vice versa (<LF><CR>). This is denoted by <CR> in the syntax portions of the function descriptions and by `'\n'` in the C examples.

- It is necessary for you to send only enough characters of the function name to distinguish it from other functions. These characters are shown in **boldface** in the syntax portion of the function descriptions.

- Functions listed as low-level give you the ability to work with most any SCSI device, no matter how complex, as long as you are aware of how the SCSI device handles phase changes and information transfer. High-level functions allow the GPIB-SCSI-A to handle all the required phases as well as all information transfers without user intervention. You should try to communicate with your devices through the high-level functions as they work faster than the low-level since only one command interpretation is necessary for a complete request. Whereas, with low-level commands, you must request several commands to complete one SCSI request.

- Even though the functions may be called by another name, if the values comprising the Command Descriptor Block created by the high-level command are identical to what is expected by a device for some other activity, there is nothing wrong with using the function if the phases

that the Target processes are similar to those expected by the original command.

- All values given in the Command Descriptor Blocks of the GPIB-SCSI-A high-level commands are in hexadecimal.

- For more information on Sense Keys, error indications, and Status bytes, see Appendix B, *Status and Message Information*.

- Some knowledge of SCSI is assumed. If you need to acquaint yourself with SCSI, or you need a review of what you know, see Appendix D, *Operation of the SCSI*.

Points to Remember in the Function Examples

Consider the following points when reading through the G mode function examples:

- The program examples are written in THINK C, using the NI-488 functions.

- The following NI-488 function call automatically sends to the GPIB-SCSI-A its Command and Status Channel talk address, and the programming message `id`, followed by a line feed (<LF>):

```
ibwrt (gpibscsia, "id\n", 3);
```

  If you are not using the National Instruments NI-488 software, be sure your program properly addresses the Command and Status Channel as well as the Data Channel when writing to and reading from the GPIB-SCSI-A.

- The devices used as the first argument of the National Instruments GPIB calls are `gpibscsia` and `scsidev`. `gpibscsia` represents the Command and Status Channel on the GPIB-SCSI-A and is the device that must be used to command the GPIB-SCSI-A and receive status and other information. `scsidev` represents the Data Channel on the GPIB-SCSI-A and must be used when communicating with a SCSI device attached to the SCSI port on the GPIB-SCSI-A.

- Variables ending in `buf` refer to character buffers created with the `calloc` memory allocation function. Assume that the size of the buffer is sufficient to process the example.

G Mode Function Descriptions

The remainder of this chapter contains a detailed description of each GPIB-SCSI-A G mode function with examples.

autotst - Enable/Disable Automatic Testing of SCSI Targets

Type: SCSI Configuration function

Syntax: **a**`autotst [target ids]`<CR>
or
a`autotst?`<CR>

Purpose: Use **a**`autotst` if you want to verify that a given set of SCSI Targets is still online and ready to receive commands.

Remarks: This command allows the user to automatically test specific Targets in order to verify that they are still online and ready to receive commands. The testing is done between the execution of G mode functions, when the GPIB-SCSI-A would otherwise be idle.

`target ids` is a list of SCSI Target ids to test. If no `target ids` are specified, the **a**`autotst` function is disabled, and no automatic testing is done. This is also the default behavior for the **a**`autotst` function.

If one or more `target ids` are specified, the GPIB-SCSI-A configures itself to automatically test those Targets. Thereafter, approximately once every three seconds, the GPIB-SCSI-A issues the Test Unit Ready command to every Target that is configured for automatic testing. The Test Unit Ready command is issued in the same manner as the **t**`stur` function. The three second timer stops when the GPIB-SCSI-A receives a valid G mode function. It is restarted after completing the function.

If a specified SCSI Target cannot be Selected (due to being powered off), a phase error occurs during the command or if the Status byte returned by a Target is CHECK CONDITION, an error condition is indicated to the user. This error is indicated by setting the ERR bit in the internal GPIB-SCSI-A status, and by setting the SCSI error code to a value in the

autotst (continued)

range TST0 to TST7 (80 to 87 hex). The lowest three bits of this error code indicate which SCSI Target id had the error. If the **srqen** function is used to enable SRQ assertion on the ERR condition, then SRQ asserts on the GPIB bus. If the **stat** function is used to enable continuous status reporting, then the current status is placed into the Command and Status Channel buffer after the error is indicated.

If you enter **a**utotst? the GPIB-SCSI-A places the Target ids that are currently configured for automatic testing into the Command and Status Channel buffer followed by a <CR><LF>. If the autotst function is currently disabled, a <CR><LF> alone is placed into the buffer. If more than one Target id is configured for automatic testing, they are separated by commas.

t**arget ids** represents a list of one or more 3-bit unsigned numbers. Correct values range from 0 to 7. If a number is entered that is too large, or if more than seven ids are listed, the GPIB-SCSI-A aborts the command with an EARG error indication.

See Also: *tstur*, *srqen*, *stat* and Appendix B, *Status and Message Information.*

Example:

```
ibwrt (gpibscsia, "stat c s\n", 9);

/* Tell GPIB-SCSI-A to send us symbolic status.
 * We are also enabling continuous reporting.
 */

ibwrt (gpibscsia, "srqen #h80\n", 11);

/* Indicate that you want to assert SRQ when
 * any error occurs.
 */

ibwrt (gpibscsia, "autotst 2, 3\n", 13);
```

autotst (continued)

```
/* Indicate that you want to automatically
 * test SCSI Target ids 2 and 3.
 */

/* Now wait for SRQ.  Once SRQ is detected,
 * read the status back into a buffer until
 * END is received from the GPIB-SCSI-A.
 */

ibrd (gpibscsia, stbuf, 100);

/* Read status information until END. */

printf ("status is: %s", stbuf);

/* Print the information. */

status is: ERR, CMPL, BSFR <CR><LF>
NGER <CR><LF>
TST3 <CR><LF>

/* An error occurred on the Test Unit Ready
 * that was issued to SCSI Target id 3.
 */
```

blksz - Set Blocksize

Type: SCSI Configuration function

Syntax: **b**lksz value<CR>
or
blksz?<CR>

Purpose: Use **b**lksz if you want to change the blocksize of data transfers between the GPIB-SCSI-A and any SCSI device.

Remarks: This command is in effect for **r**ead, **rd**ext, **w**rite, and **wr**ext. These four commands specify a data transfer length by indicating the number of blocks to transfer. The GPIB-SCSI-A takes the number of blocks requested to transfer in any of these commands and multiplies this by the number assigned with **b**lksz. This is the total count of bytes the GPIB-SCSI-A plans to transfer between the SCSI and GPIB during the command. The default value for this command is 512.

If you enter **b**lksz?, the GPIB-SCSI-A places the current value of **b**lksz into the Command and Status Channel buffer followed by a <CR><LF>.

value represents a 16-bit unsigned number. Correct values range from 1 to 65,535. If a number that is too large is entered, or if there is no question mark and no value following the command, the GPIB-SCSI-A aborts the command with an EARG error indication.

The assignment made by this function remains in effect until you call **b**lksz again or turn off the GPIB-SCSI-A.

See Also: *read*, *rdext*, *write*, and *wrext.*

blksz (continued)

Examples:

1.
```
ibwrt (gpibscsia, "blksz?\n", 7);
/* Ask for the current blocksize setting. */
ibrd (gpibscsia, infobuf, 10);
/* Get the response from the GPIB-SCSI-A. */
printf ("response:  %s", infobuf);
/* Display the data. */
```
response: 512<CR><LF>

2.
```
ibwrt (gpibscsia, "blksz 532\n", 10);
/* Set the blocksize to 532. */
```

cmd - Build SCSI Command Descriptor Block and Execute SCSI Command Phase

Type: SCSI Function

Syntax: **cmd** command byte[, command bytes]<CR>

Purpose: Use **cmd** to build the Command Descriptor Block for your SCSI device if the high-level commands provided with the GPIB-SCSI-A do not perform well with your device. After being built, **cmd** transfers the Command Descriptor Block to a SCSI Target during the Command phase.

Remarks: Use this command in your low-level command sequence to tell the selected Target what to do if the high-level commands offered by the GPIB-SCSI-A do not work with your SCSI device. This command performs the Command phase for the SCSI bus.

command byte(s) indicates the bytes to go into the Command Descriptor Block. The command byte(s) go into the Command Descriptor Block in the order that you enter them – that is, if you enter #h3 as the first command byte, the first byte in the Command Descriptor Block will be a 3. You must enter at least one command byte. Any more are optional. The maximum number of command bytes that can be entered are 25. This limit does not impose problems as the SCSI specification currently indicates a maximum Command Descriptor Block size of 12 bytes. The GPIB-SCSI-A accepts more bytes for future expansion and for SCSI devices that use vendor uniquely determined Command Descriptor Block lengths greater than 12 bytes.

This command assumes that the SCSI is in a proper state to accept command data. That is, this command presumes that you have already issued the **getscsi** command to arbitrate for the SCSI followed by the **selwa** or **selwo** command to select the desired Target. This command then attempts to give the Command Descriptor Block to the selected SCSI device.

cmd (continued)

If the Target is not in the Command phase, **cmd** aborts the operation with an error indication of EPHS.

If you use more than 25 `command bytes` or you do not use at least one `command byte`, **cmd** aborts the operation with an error indication of EARG.

See Also: Appendix D, *Operation of the SCSI.*

Example:

```
ibwrt (gpibscsia, "getscsi\n", 8);

/* Arbitrate for the SCSI. */

ibwrt (gpibscsia, "tid 3\n" 6);

/* Indicate that you want to communicate with
 * the SCSI device with SCSI id 3.
 */

ibwrt (gpibscsia, "selwo\n", 6);

/* Select the device at SCSI ID 3 without SCSI
 * ATN* signal.
 */

ibwrt (gpibscsia, "cmd #h1b, #h0, #h0, #h0, #h0,
       #h0\n", 34);

/* Create and send to the selected Target the
 * Command Descriptor Block containing the
 * Group 0 command Start/Stop Unit.
 */
```

cmp - Complete the SCSI Command Sequence By Processing the Status and Message In Phases

Type: SCSI Function

Syntax: **cmp**<CR>

Purpose: Use **cmp** to finish the low-level command sequence which you would use if your device is having problems with the high-level commands performed by the GPIB-SCSI-A.

Remarks: Use the **cmp** command in your low-level command sequence to receive the status and message bytes that the SCSI Target sends before completing a command. The Status phase can only transfer one byte, but the device might transfer more than one byte during the Message In phase.

This command places all the information bytes received into the buffer of the Command and Status Channel. There is no marker placed after these information bytes to indicate which of these bytes are valid status and message bytes and which ones are GPIB-SCSI-A status bytes. The reason for this is that most all byte values can be used for message bytes and no arbitrary value can be chosen as a marker. Therefore, the one sure method of analyzing this data, if necessary, is to know that the status data can only be 1-byte long and most messages are 1-byte long (unless the first message byte indicates extended messages, in which case there is a prescribed method for knowing the length of the message). With this in mind, you can treat the first byte in the buffer of the Command and Status Channel as the status byte and the second as the only message byte, or the beginning of an extended message.

If there is anything following **cmp**, the command aborts the operation with an EARG indication.

cmp (continued)

If, at any time during the operation of **c**mp, the selected SCSI Target is not in the phase that the GPIB-SCSI-A expects that it should be, **c**mp aborts the operation with an EPHS indication.

See Also: Appendix D, *Operation of the SCSI.*

Example:

This example continues with the example started previously in **cmd**.

```
ibwrt (gpibscsia, "cmd #h1b, #h0, #h0, #h0, #h0,
       #h0\n", 34);

/* Create and send to the selected Target the
 * Command Descriptor Block containing the
 * Group 0 command Start/Stop Unit.
 */

ibwrt (gpibscsia, "cmp\n", 4);

/* Because the Start/Stop Unit command does not
 * transfer any data, you can now get the Status
 * phase byte and the Message In phase byte(s).
 */
```

config - Read/Change GPIB-SCSI-A Configuration

Type: General Use function

Syntax: `config mask [, size]`<CR>
or
`config?`<CR>

Purpose: Use `config` when you want the GPIB-SCSI-A to change or report its current operating configuration.

Remarks: Use this command when you want to find out the current configuration of the GPIB-SCSI-A. You can also use this command to change some of the configuration parameters within the box.

The `mask` parameter contains bits that allow you to change some of the configuration parameters of the GPIB-SCSI-A. The valid bits of `mask` are shown in Figure 7-1. Bits marked as Reserved are reserved for future use, and must be zero.

Bit	7	6	5	4	3	2	1	0
	Reserved		BufMode		Rsvd	NoDisc	Reserved	

Figure 7-1. Valid Bits of mask

Use the NoDisc bit of `mask` in order to disable the disconnection/reconnection feature during high-level commands. The IDENTIFY message that the GPIB-SCSI-A sends to a Target after Selection contains a bit that indicates that the GPIB-SCSI-A supports disconnection/reconnection. If the NoDisc bit is set, then this bit is not set in the IDENTIFY, and the Target does not attempt to disconnect from the SCSI bus during high-level commands.

config (continued)

The BufMode bits of `mask` can be used to change the buffering method that the GPIB-SCSI-A uses for data transfer during certain high-level commands. The high-level commands that use this buffering method are **h**`cmd`, **rd**`ext`, **r**`ead`, **wre**`xt`, and **w**`rite`. See Table 7-1 for proper values of the BufMode bits. For a complete description of each buffering method, refer to *Buffering Methods* in Chapter 3, *Technical Information.*

Table 7-1. Buffering Methods for High-Level Commands

Description	BufMode
Do not change the buffering method.	0
Use the Straight Through Buffering method.	1
Use the Single Buffering method.	2
Use the Double Buffering method.	3

Use the `size` parameter to change the size of the internal buffer used by the GPIB-SCSI-A. **h**`cmd`, **rd**`ext`, **r**`ead`, **wre**`xt`, and **w**`rite`, use this buffer when Single or Double Buffering is enabled. The actual buffer size is set to the lower of the `size` parameter and the amount of DRAM available for use. If you do not indicate `size` as a parameter, no change is made to the current buffer size.

If you enter **co**`nfig?`, the GPIB-SCSI-A places the last used values of `mask` and the current buffer size into the Command and Status Channel's buffer followed by a <CR><LF>.

`mask` represents an 8-bit unsigned number. Correct values range from 0 to 52. `size` represents a 32-bit unsigned number. Correct values range from 2 to 4,294,967,296.

config (continued)

If an invalid number is entered for either value, or if there is no question mark and no value following the command, the GPIB-SCSI-A aborts the command with an EARG error indication.

See Also: *Buffering Methods* in Chapter 3, *Technical Information.*

Example:

```
ibwrt (gpibscsia, "config #h20, 307200\n", 21);

/* Configure the GPIB-SCSI-A to use Single
 * buffering and a buffer size of 300K.
 */

ibwrt (gpibscsia, "config?\n", 8);

/* Ask for the current configuration. */

ibrd (gpibscsia, infobuf, 20);

/* Get the response from the GPIB-SCSI-A. */

printf ("response:  %s", infobuf);

/* Display the data. */

response:  32,229376<CR><LF>

/* Single buffering is enabled, and the
 * largest buffer size possible is 224K.
 */
```

dtin - Transfer Data In Information from Selected SCSI Target

Type: SCSI Function

Syntax: **dtin**<CR>

Purpose: Use **dtin** if the Target is in the Data In phase and you want to receive data from the selected Target. This is a low-level command that you must use if the high-level commands provided by the GPIB-SCSI-A do not work properly with your device.

Remarks: Use the **dtin** command in your low-level command sequence to perform the Data In phase for the SCSI bus.

Because this command is used to transfer SCSI data (which is usually grouped in blocks) to the GPIB (which does not group data in blocks), the GPIB-SCSI-A uses the GPIB END condition to prevent locking up the system. When the GPIB-SCSI-A detects that it is about to send the last data byte from the SCSI, the GPIB-SCSI-A asserts the EOI* signal to indicate that the next byte will be the last GPIB byte. This stops your device from receiving data and completes the cycle.

If the Target enters the Status phase before entering the Data In phase, **dtin** aborts the operation with an error indication of EPHS.

If there is anything following **dtin**, the command aborts the operation with an EARG indication.

See Also: *read*, *rdext*, and Appendix D, *Operation of the SCSI.*

dtin (continued)

Example:

This example is an entire low-level command sequence. This example performs a Group 0 SCSI READ command sequence that reads one block of data from a SCSI disk drive with a Target ID of 6 and a blocksize of 256 bytes. Most of this example does at a low-level what the high-level **read** command does automatically.

```
ibwrt (gpibscsia, "stat c n\n", 9);

/* Instruct the GPIB-SCSI-A to report numerical
 * status continuously.
 */

ibwrt (gpibscsia, "tid 6\n", 6);

/* Request the GPIB-SCSI-A to communicate
 * with SCSI Target with an ID of 6.
 */

ibwrt (gpibscsia, "blksz 256\n", 10);

/* Tell the GPIB-SCSI-A that the drive has
 * a blocksize of 256 bytes.  This information
 * can be found either in the documentation of
 * the SCSI disk drive or by executing the SCSI
 * MODE SENSE command either through a low-
 * level command sequence or with the high-
 * level mdsns command provided by the
 * GPIB-SCSI-A.
 */

ibwrt (gpibscsia, "srqen #h18\n", 11);

/* Set up the GPIB-SCSI-A to request service
 * when the Data Channel is ready or the
 * GPIB-SCSI-A is ready for the next command.
 */
```

dtin (continued)

```
ibwrt (gpibscsia, "getscsi\n", 8);

/* Tell the GPIB-SCSI-A to arbitrate for the
 * SCSI bus.
 */

ibrd (gpibscsia, infobuf, 100);

/* Get the response from the GPIB-SCSI-A. */

get_stat(&ibstat,&gpiberr,&scsierr,infobuf);

/* Call a routine to convert the character
 * strings representing numerical values to
 * binary data.
 */

if (ibstat < 0)

/* The status would be negative if any error
 * occurred with the GPIB or SCSI ports.
 */

      processerr (ibstat)

/* If error, go and process it. */

else
{
      ibwrt (gpibscsia, "selwo\n", 6);

/* Continue with the operation.  After each
 * step, check the status as you did after
 * getscsi above.  Because this does not show
 * anything new, it is not done further in
 * this example.  selwo causes the GPIB-SCSI-A
 * to attempt selecting a SCSI device at ID 6.
 */
```

dtin (continued)

```
ibwrt (gpibscsia, "cmd #h8, #h0, #h0, #h1, #h1,
      #h0\n", 33);

/* Build the SCSI Command Descriptor Block to
 * execute the Group 0 READ command. Verify
 * that the Target you select is in the Command
 * phase before you issue this command.  Analyze
 * the status returned by the GPIB-SCSI-A or
 * analyze the serial poll response byte of the
 * GPIB-SCSI-A to do this.
 */

ibwrt (gpibscsia, "dtin\n", 5);

/* This alerts the GPIB-SCSI-A that you want to
 * receive data into your GPIB port from the
 * selected SCSI device.
 */

state = wt_rdy()

/* Wait for the GPIB-SCSI-A to request service.
 * State then contains a value of either DCR
 * (which indicates that the Target is in the
 * Data In phase) or RDY (which indicates that
 * the Target, due to some error, went into the
 * Status phase).
 */

if (state == DCR)
{

      ibrd (scsidev, databuf, 256);

/* Because the Data Channel is ready, read in
 * the data.
 */

      ibwrt (gpibscsia, "cmp\n", 4);
```

dtin (continued)

```
/* After transferring the data and ensuring
 * that the Target is in the Status phase,
 * a call to cmp allows the GPIB-SCSI-A to
 * process the Status and Message In phases.
 */

}
else                    /* state == RDY */
{

      ibwrt (gpibscsia, "cmp\n", 4);

/* Because you have a box ready indication
 * from the GPIB-SCSI-A, the Target went into
 * the Status phase instead of a Data In phase.
 * The call to cmp allows the GPIB-SCSI-A to
 * process the Status and Message In phases.
 */

      unexpected_abort()

/* Because there was no data transferred,
 * some sort of error occurred.  Perform
 * desired type of error recovery.
 */

}
```

dtout - Transfer Data Out Information to Selected SCSI Target

Type: SCSI Function

Syntax: **d**tout<CR>

Purpose: Use the **d**tout command in your low-level command sequence to perform the Data Out phase for the SCSI bus.

Remarks: You must use the **d**tout command in your low-level command sequence to perform the Data Out phase for the SCSI bus.

Because this command is used to transfer GPIB data (which is not grouped in blocks) to the SCSI (which is usually grouped in blocks), the GPIB-SCSI-A uses the GPIB END message to prevent locking up the system.

You must assert the GPIB EOI* signal on the last byte of data transferred to the Data Channel. At this time, the GPIB-SCSI-A transfers the **p**ad byte specified by **p**ad until the selected SCSI device changes from the Data Out phase.

If the Target enters the Status phase before entering the Data Out phase, **d**tout aborts the operation with an error indication of EPHS.

If the selected Target changes from the Data Out phase before the GPIB-SCSI-A has received the END message from the GPIB, the GPIB-SCSI-A terminates this command with an EPHS error.

If there is anything following **d**tout, the command aborts the operation with an EARG indication.

See Also: *pad*, *wrext*, *write*, and Appendix D, *Operation of the SCSI.*

dtout (continued)

Example:

This example is an entire low-level command sequence. This example performs a Group 0 SCSI WRITE command sequence that writes one block of data to a SCSI disk drive with a Target ID of 5 and a blocksize of 532 bytes. Most of this example does at a low-level what the high-level **write** command does automatically.

```
ibwrt (gpibscsia, "stat c n\n", 9);

/* Instruct the GPIB-SCSI-A to report
 * numerical status continuously
 */

ibwrt (gpibscsia, "tid 5\n", 6);

/* Request the GPIB-SCSI-A to communicate with
 * SCSI Target with an ID of 5.
 */

ibwrt (gpibscsia, "blksz 532\n", 10);

/* Tell to the GPIB-SCSI-A that the drive has
 * a blocksize of 532 bytes.  This information
 * can be found either in the documentation of
 * the SCSI disk drive or by executing the SCSI
 * MODE SENSE command either through a low-
 * level command or with the high-level mdsns
 * command provided by the GPIB-SCSI-A.
 */

ibwrt (gpibscsia, "srqen #h18\n", 11);

/* Set up the GPIB-SCSI-A to request service
 * when the Data Channel is ready or the
 * GPIB-SCSI-A is ready for the next command.
 */
```

dtout (continued)

```
ibwrt (gpibscsia, "pad 13\n", 7);

/* Request the GPIB-SCSI-A to pad data transfers
 * to the SCSI with the carriage return
 * character
 */

ibwrt (gpibscsia, "getscsi\n", 8);

/* Tell the GPIB-SCSI-A to arbitrate for the
 * SCSI bus.
 */

ibrd (gpibscsia, infobuf, 100);

/* Get the response from the GPIB-SCSI-A. */

get_stat (&ibstat, &gpiberr, &scsierr, infobuf);

/* Call a routine to convert the character
 * strings representing numerical values to
 * binary data.
 */

if (ibstat < 0)

/* The status would be negative if any form of
 * error occurred with the GPIB or SCSI ports.
 */

      processerr (ibstat)

/* If error, go and process it. */

else
{
```

dtout (continued)

```
        ibwrt (gpibscsia, "selwo\n", 6);

    /* Continue with the operation.  After each
     * step, check the status as you did after
     * getscsi above.  Because this does not show
     * anything new, it is not done further in this
     * example.  selwo causes the GPIB-SCSI-A to
     * attempt selecting a SCSI device at ID 5.
     */


   ibwrt (gpibscsia, "cmd #ha, #h0, #h0, #h0, #h1,
         #h0\n", 33);

    /* Build the SCSI Command Descriptor Block to
     * execute the Group 0 WRITE command. Verify
     * that the Target you select is in the
     * Command Phase before you issue this command
     * by analyzing the status returned by the
     * GPIB-SCSI-A or by analyzing the serial poll
     * response byte of the GPIB-SCSI-A.
     */


    ibwrt (gpibscsia, "dtout\n", 6);

    /* This alerts the GPIB-SCSI-A that you want to
     * send data from your GPIB port to the selected
     * SCSI Target.
     */

    state = wt_rdy();

    /* Wait for the GPIB-SCSI-A to request service.
     * State then contains a value of either DCR
     * (which indicates that the Target is in the
     * Data Out phase) or RDY (which  indicates that
     * the Target, due to some error, went into the
     * Status phase).
     */
```

dtout (continued)

```
if (state == DCR)
{

      ibwrt (scsidev,"Data to be stored.",18);

/* Because the Data Channel is ready, send out
 * the data.
 */

      ibwrt (gpibscsia, "cmp\n",4);

/* After transferring the data and ensuring
 * that the Target is in the Status phase, a
 * call to cmp allows the GPIB-SCSI-A to process
 * the Status and Message In phases.
 */

}
else                /* state == RDY */
{

      ibwrt (gpibscsia, "cmp\n",4);

/* Because you have a box ready indication
 * from the GPIB-SCSI-A, the Target went into
 * the Status phase instead of a Data Out
 * phase.  The call to cmp allows the
 * GPIB-SCSI-A to process the Status and Message
 * In phases.
 */

      unexpected_abort();

/* Because there was no data transferred,
 * an error occurred.  Perform the desired
 * type of error recovery.
 */

}
```

format - Format Unit

Type: SCSI function

Syntax: `format vendor unique byte[, interleave]` <CR>

Purpose: Use `format` to command the GPIB-SCSI-A to process the Group 0 SCSI FORMAT UNIT command.

Remarks: The GPIB-SCSI-A uses the following Command Descriptor Block to command the Target to process `format`. Notice how the parameters to the `format` command are used in the creation of the Command Descriptor Block.

Bit / Byte	7	6	5	4	3	2	1	0
0	04							
1	LUN			00				
2	Vendor Unique Byte							
3	Interleave (Most Significant Byte)							
4	Interleave (Lease Significant Byte)							
5	VCB		00					

The Vendor Unique Byte and Interleave values in the Command Descriptor block above are given as parameters to the `format` command. The LUN corresponds to the last value assigned with the `lun` command. The VCB corresponds to the last value assigned with the `vcb` command.

The `interleave` field requests that the logical blocks on the device be related in a specific fashion to the physical blocks to facilitate speed-matching. An `interleave` value of 0 requests that the Target use its default interleave. An interleave value of 1 requests that consecutive logical blocks be placed in consecutive order. Values of 2 or greater are vendor-unique. In the `format` command, the

format (continued)

`interleave` is optional. If you do not indicate an `interleave` as a parameter, the GPIB-SCSI-A assumes an interleave value of 0.

During the execution of this command, if the GPIB-SCSI-A encounters a phase which it did not expect, an EPHS error indication results. For a list of the expected phases, refer to the section titled *Handling of SCSI Phases in G Mode* in Chapter 6, *Programming in G Mode.*

Refer to your SCSI device documentation for the expected values in each byte of the Command Descriptor Block as well as the SCSI phases that the device creates.

`vendor unique byte` represents an 8-bit unsigned number. Correct values range from 0 to 255. `interleave` is a 16-bit unsigned number. Correct values range from 0 to 65,535. If a number that is too large is entered for either value, there are no numbers, or there is a syntax error in a number, the GPIB-SCSI-A aborts the command with an EARG error indication.

Examples:

1.
```
ibwrt (gpibscsia, "format 0, 1\n", 12);

/* Tell the GPIB-SCSI-A to do a SCSI FORMAT UNIT
 * command.  The vendor unique byte is 0 and
 * the interleave factor is one.
 */
```

2.
```
ibwrt (gpibscsia, "format #h10\n", 12);

/* Tell the GPIB-SCSI-A to do a SCSI FORMAT UNIT
 * command.  The vendor unique byte is 0x10 and
 * the interleave factor is not specified,
 * causing the GPIB-SCSI-A to use a 0.
 */
```

getscsi - Arbitrate for the SCSI Bus

Type: SCSI Function

Syntax: **g**`etscsi`<CR>

Purpose: Use **g**`etscsi` to arbitrate for the SCSI bus if the high level commands performed by the GPIB-SCSI-A do not meet your needs and you need to perform low level commands with your device.

Remarks: This is the first command that you need to use in your low level command pattern if the high-level commands offered by the GPIB-SCSI-A do not work with your SCSI device. This command performs the Arbitration phase for the SCSI bus.

If the SCSI bus is currently being used by another Initiator, this command aborts with an EARB error indication.

If there is anything following **g**`etscsi`, the command aborts and returns an EARG indication.

If this command completes and there is no error indicated, you can proceed with the low level command sequence as the GPIB-SCSI-A now has control of the SCSI bus.

See Also: Appendix D, *Operation of the SCSI.*

Example:

```
ibwrt (gpibscsia, "getscsi\n", 8);

/* Arbitrate for the SCSI bus. */
```

hcmd - Execute a High-Level SCSI Command

Type: SCSI function

Syntax:
```
hcmd command bytes<CR>
hcmd command bytes, i count<CR>
hcmd command bytes, o count<CR>
```

Purpose: Use **hcmd** if you want to issue a high-level SCSI command, but that command is not provided in the high-level functions of the GPIB-SCSI-A.

Remarks: This function is used to process an entire high-level SCSI command. It handles all of the needed SCSI phases for any SCSI command, including data transfer.

`command bytes` indicates the bytes to go into the Command Descriptor Block. If nothing follows the `command bytes`, the command does not require a Data In or Data Out phase. If a Data In phase is required, the `command bytes` should be followed by `i count`. If a Data Out phase is required, the `command bytes` should be followed by `o count`.

`count` represents a 32-bit unsigned number. It is the number of bytes that the user expects the GPIB-SCSI-A to transfer during the Data In or Data Out phases. Correct values range from 1 to 4,294,967,295. During commands that require a Data Out phase, if this count is not met, the value specified by the **pad** command is used to pad the transfer to the requested count.

If during the execution of this command, the GPIB-SCSI-A encounters a phase which it did not expect, an EPHS error indication results. For a list of the expected phases, refer to the section titled *Handling of SCSI Phases in G Mode* in Chapter 6, *Programming in G Mode.*

The `command bytes` go into the Command Descriptor Block in the order that you enter them – that is, if you enter

hcmd (continued)

#h3 as the first `command byte`, the first byte in the Command Descriptor Block is a 3. You must enter at least one `command byte`. Any more are optional. The number maximum of `command bytes` that can be entered are 25.

This limit does not impose problems as the SCSI specification currently indicates a maximum Command Descriptor Block size of 12 bytes. The GPIB-SCSI-A accepts more bytes for future expansion and for SCSI devices that use vendor uniquely determined Command Descriptor Block lengths greater than 12 bytes.

If you use more than 25 `command bytes`, you do not use at least one `command byte`, or the value of `count` is invalid, **h**`cmd` aborts the operation with an error indication of EARG.

See Also: *pad* and Chapter 6, *Programming in G Mode.*

Examples:

1. This example causes the GPIB-SCSI-A to issue a Group 0 SCSI SEEK command to the Target with a SCSI ID of 3. The Logical Unit Number used is 2, and the command seeks to Logical Block Address 100.

```
ibwrt (gpibscsia, "tid 3\n", 6);

/* Request the GPIB-SCSI-A to communicate
 * with the SCSI Target with an ID of 3.
 */

ibwrt (gpibscsia, "hcmd #h0b, #h40, 0, 100, 0,
        0\n", 30);

/* Issue a SEEK to Logical Block Address 100.
 * The SEEK command does not have a data
 * phase, so you do not need to transfer
 * anything to/from the Data Channel.
 */
```

hcmd (continued)

2. This example causes the GPIB-SCSI-A to read 257 bytes of data from another GPIB-SCSI-A that is executing in S mode. The S mode GPIB-SCSI-A has a SCSI id of 5.

```
ibwrt (gpibscsia, "tid 5\n", 6);

/* Request the GPIB-SCSI-A that you want to
 * communicate with the SCSI Target with an ID
 * of 5.
 */

ibwrt (gpibscsia, "hcmd #hdd, 0, 0, 0, 1, 1 i
        257\n", 33);

/* Tell the GPIB-SCSI-A that you want to read
 * 257 bytes of data from the S mode
 * GPIB-SCSI-A at ID 5.  Issue an S mode
 * brd command with a count of 257.  Specify
 * "i 257" so that the G mode GPIB-SCSI-A
 * expects to transfer 257 bytes during the
 * Data In phase.
 */

ibrd (scsidev, databuf, 257);

/* Read the data from the S mode GPIB-SCSI-A
 * through the Data Channel.
 */
```

id - Identify System

Type: General Use function

Syntax: **id**<CR>

Purpose: Use **id** if you want to know the revision level of your firmware, or if you wish to know how much RAM is installed in your GPIB-SCSI-A.

Remarks: The identification is returned in three strings. The first two strings identify the company product model, the software revision level, and a copyright notice. The third string identifies the number of bytes of RAM in the GPIB-SCSI-A that are available for use as buffer space.

Example:

```
ibwrt (gpibscsia, "id\n", 3);

/* Ask for GPIB-SCSI-A system identification. */

ibrd (gpibscsia, idbuf, 75);

/* Get the system identification. */

printf ("response:  %s", idbuf);

/* Display the identification string. */
```

```
response:   GPIB-SCSI-A, Rev. 1.0<CR><LF>
       (c)1991 National Instruments<CR><LF>
       224K bytes RAM<CR><LF>
```

inquiry - Inquiry

Type: SCSI function

Syntax: `inquiry allocation length`<CR>

Purpose: Use `inquiry` to command the GPIB-SCSI-A to process the Group 0 SCSI INQUIRY command.

Remarks: The GPIB-SCSI-A uses the following Command Descriptor Block to command the Target to process `inquiry`. Notice how the parameter to the `inquiry` command is used in the creation of the Command Descriptor Block.

Bit / Byte	7	6	5	4	3	2	1	0
0	12							
1	LUN			00				
2	00							
3	00							
4	Allocation Length							
5	VCB			00				

The Allocation Length in the Command Descriptor block above is given as a parameter to the `inquiry` command. The LUN corresponds to the last value assigned with the `lun` command. The VCB corresponds to the last value assigned with the `vcb` command.

The Allocation Length is the number of bytes that the Initiator has allocated for returned Inquiry data. An Allocation Length of 0 indicates that no Inquiry data is transferred. This condition is not considered an error. Any other value indicates the maximum number of bytes that are transferred. The Target terminates the Data In phase when Allocation Length bytes have transferred or when all available Inquiry data has transferred to the Initiator, whichever is less.

inquiry (continued)

During the execution of this command, if the GPIB-SCSI-A encounters a phase which it did not expect, an EPHS error indication results. For a list of the expected phases, refer to the section titled *Handling of SCSI Phases in G Mode* in Chapter 6, *Programming in G Mode.*

Refer to your SCSI device documentation for the expected values in each byte of the Command Descriptor Block, the SCSI phases that the device creates, and the format and meaning of the returned Inquiry data.

`allocation length` represents an 8-bit unsigned number. Correct values range from 0 to 255. If a number that is too large is entered, there is a syntax error in the number, or there is no number, the GPIB-SCSI-A aborts the command with an EARG error indication.

Example:

```
ibwrt (gpibscsia, "inquiry 100\n", 12);

/* Tell the GPIB-SCSI-A to do a SCSI INQUIRY
 * command.  The allocation length is 100
 * bytes.
 */

ibrd (scsidev, inqbuf, 100);

/* Get the data from the Data Channel of the
 * GPIB-SCSI-A.
 */

processinq (inqbuf);

/* Process the buffer. */
```

lun - Set Logical Unit Number

Type: SCSI Configuration function

Syntax: `lun value`<CR>
or
`lun?`<CR>

Purpose: Use `lun` if you want to change the value that the GPIB-SCSI-A uses in the Logical Unit Number portion of any Command Descriptor Block created during a high-level command sequence.

Remarks: This command is in effect for any of the high-level GPIB-SCSI-A commands that communicate with the SCSI. For more information on the Logical Unit Number or the command descriptor blocks, refer to Appendix D, *Operation of the SCSI*. The default value for `lun` is 0.

If you enter `lun?`, the GPIB-SCSI-A places the current value of `lun` into the Command and Status Channel buffer followed by a <CR><LF>.

`value` represents a 3-bit unsigned number. Correct values range from 0 to 7. If a number that is too large is entered, or if there is no question mark and no value following the command, the GPIB-SCSI-A aborts the command with an EARG error indication.

The assignment made by this function remains in effect until you call `lun` again or turn off the GPIB-SCSI-A.

See Also: Appendix D, *Operation of the SCSI.*

lun (continued)

Examples:

1.
```
ibwrt (gpibscsia, "lun?\n", 5);

/* Ask for the GPIB-SCSI-A's current lun
 * setting.
 */

ibrd (gpibscsia, infobuf, 10);

/* Get the response from the GPIB-SCSI-A. */

printf ("response:  %s\n", infobuf);

/* Display the data. */
```

response: 0<CR><LF>

2.
```
ibwrt (gpibscsia, "lun 3\n", 6);

/* Set the lun value to 3. */
```

mdsct - Mode Select

Type: SCSI function

Syntax: `mdsct parameter list length`<CR>

Purpose: Use **mdsct** to command the GPIB-SCSI-A to process the Group 0 SCSI MODE SELECT command.

Remarks: The GPIB-SCSI-A uses the following Command Descriptor Block to command the Target to process **mdsct**. Notice how the parameter to the **mdsct** command is used in the creation of the Command Descriptor Block.

Bit / Byte	7	6	5	4	3	2	1	0
0	15							
1	LUN			00				
2	00							
3	00							
4	Parameter List Length							
5	VCB		00					

The Parameter List Length in the Command Descriptor Block above is given as a parameter to the **mdsct** command. The LUN corresponds to the last value assigned with the **lun** command. The VCB corresponds to the last value assigned with the **vcb** command.

The Parameter List Length is the number of bytes that the Initiator can send to the SCSI Target during the Data Out phase. A Parameter List Length of 0 indicates that no data is transferred. This condition is not considered an error. Any other value indicates the number of bytes transferred.

mdsct (continued)

During the execution of this command, if the GPIB-SCSI-A encounters a phase which it did not expect, an EPHS error indication results. For a list of the expected phases, refer to Chapter 6, *Handling of SCSI Phases in G Mode*, *Commands That Require a Data Out Phase.*

Refer to your SCSI device documentation for the expected values in each byte of the Command Descriptor Block, the SCSI phases that the device creates, and the format and meaning of the parameter list data.

Allocation Length represents an 8-bit unsigned number. Correct values range from 0 to 255. If a number that is too large is entered, there is a syntax error in the number, or there is no number, the GPIB-SCSI-A aborts the command with an EARG error indication.

See Also: *mdsns.*

Example:

```
ibwrt (gpibscsia, "mdsct 12\n", 9);

/* Tell the GPIB-SCSI-A to do a SCSI MODE
 * SELECT command.  The parameter list length
 * is 12 bytes.
 */

ibwrt (scsidev,"\000\000\000\001\000\377
\377\377\000\000\001\000", 12);

/* Put the data representing the parameter list
 * to the Data Channel.
 */
```

mdsns - Mode Sense

Type: SCSI function

Syntax: **mdsn**s allocation length<CR>

Purpose: Use **mdsn**s to command the GPIB-SCSI-A to process the Group 0 SCSI MODE SENSE command.

Remarks: The GPIB-SCSI-A uses the following Command Descriptor Block to command the Target to process **mdsn**s. Notice how the parameter to the **mdsn**s command is used in the creation of the Command Descriptor Block.

Bit / Byte	7	6	5	4	3	2	1	0
0	1A							
1	LUN			00				
2	00							
3	00							
4	Allocation Length							
5	VCB		00					

The Allocation Length in the Command Descriptor block above is given as a parameter to the **mdsn**s command. The LUN corresponds to the last value assigned with the **l**un command. The VCB corresponds to the last value assigned with the **v**cb command.

The Allocation Length is the number of bytes that the Initiator has allocated for returned **mdsn**s data. An Allocation Length of 0 indicates that no **mdsn**s data is transferred. This condition is not considered an error. Any other value indicates the maximum number of bytes that are transferred. The Target terminates the Data In phase when Allocation Length bytes have transferred or when all available **mdsn**s data have transferred to the Initiator, whichever is less.

mdsns (continued)

During the execution of this command, if the GPIB-SCSI-A encounters a phase which it did not expect, an EPHS error indication results. For a list of the expected phases, refer to Chapter 6, *Handling of SCSI Phases in G Mode*, *Commands That Require a Data In Phase.*

Refer to your SCSI device documentation for the expected values in each byte of the Command Descriptor Block, the SCSI phases that the device creates, and the format and meaning of the returned MODE SENSE data.

`allocation length` represents an 8-bit unsigned number. Correct values range from 0 to 255. If a number that is too large is entered, there is a syntax error in the number, or there is no number, the GPIB-SCSI-A aborts the command with an EARG error indication.

See Also: *mdsct.*

Example:

```
ibwrt (gpibscsia, "mdsns 100\n", 10);

/* Tell the GPIB-SCSI-A to do a SCSI MODE SENSE
 * command.  The allocation length is 100
 * bytes.
 */

ibrd (scsidev, mdsbuf, 100);

/* Get the data from the Data Channel. */

processmds (mdsbuf);

/* Process the buffer. */
```

msgin - Transfer Message Bytes from the Target to the GPIB-SCSI-A

Type: SCSI Function

Syntax: `msgin`<CR>

Purpose: Use `msgin` if the Target is in the Message In phase and you want to receive these message bytes. This is a low-level command that you only need to use if the high-level commands provided by the GPIB-SCSI-A do not work properly with your device.

Remarks: You must use the `msgin` command in your low-level command sequence to receive message bytes during the Message In phase. More than one message byte can be sent during one of these phases. The `msgin` command automatically gets all the message bytes from the SCSI device.

This command places all the message bytes received into the Command and Status Channel buffer. There is no marker placed after these information bytes to indicate which of the bytes are valid message bytes or which ones are GPIB-SCSI-A status bytes. The reason for this is that most all byte values can be used for message bytes and no arbitrary value can be chosen as a marker. Therefore, the one sure method of analyzing this data, if necessary, is to know that most messages are one byte long (unless the first message byte indicates extended messages, in which case there is a prescribed method for knowing the total length of the message). With this in mind, you can treat the first byte in the buffer of the Command and Status Channel as the only message byte, or the beginning of an extended message.

If there is anything following `msgin`, the command aborts the operation with an EARG indication.

See Also: Appendix B, *Status and Message Information*, and Appendix D, *Operation of the SCSI.*

msgin (continued)

Example:

```
ibwrt (gpibscsia, "msgin\n", 6);

/* After determining that the Target is in the
 * Message In phase, you must specify this
 * command for the GPIB-SCSI-A to obtain the
 * message bytes from the Target.
 */

ibrd (gpibscsia, msgbuf, 258);

/* Get all possible bytes from the Command and
 * Status Channel buffer.  If there were not
 * 258 bytes in the buffer, END would have been
 * asserted on the last transfer.
 */
```

msgout - Transfer Message Bytes from the GPIB-SCSI-A to the SCSI Target

Type: SCSI Function

Syntax: **msgo**ut message byte[, message bytes]<CR>

Purpose: Use **msgo**ut if the Target is in the Message Out phase and you need to send message bytes. This is a low-level command that you only need to use if the high-level commands provided by the GPIB-SCSI-A do not work properly with your device.

Remarks: This is the command that you will need to use in your low-level command sequence to send message bytes during the Message Out phase. More than one message byte can be sent during one of these phases.

message byte(s) indicates the bytes to be sent as message bytes. The message bytes are sent in the order that you enter them in the command; that is, if you enter #h3 as the first message byte, the first byte sent is a 3. You must enter at least one message byte. Any more are optional. The maximum number of message bytes that can be entered is 258. This limit does not impose problems as the SCSI specification currently indicates that the longest transfer of message bytes can be 258.

If the Target is not in the Message Out phase, **msgo**ut aborts the operation with an error indication of EPHS.

If you use more than 258 message bytes or you do not use at least one message byte, **msgo**ut aborts the operation with an error indication of EARG.

msgout (continued)

See Also: Appendix B, *Status and Message Information*, and Appendix D, *Operation of the SCSI.*

Example:

```
ibwrt (gpibscsia, "msgout #hC0\n", 12);

/* Send the Identify message byte to the SCSI
 * device to establish the physical path
 * connection between an initiator and Target
 * for a particular logical unit.  Also, with
 * bit 6 set, you indicate that you are an
 * Initiator that can support disconnection and
 * reconnection.
 */
```

pad - Set Pad Byte

Type: SCSI Configuration function

Syntax: **p**ad value<CR>
or
pad?<CR>

Purpose: Use **p**ad if you want to change the value that the GPIB-SCSI-A uses to pad data coming in from the GPIB port and going out over the SCSI port.

Remarks: This command is in effect for **h**cmd, write and **wre**xt. When you use one of the above commands, you must indicate a transfer length (or, in the case of **h**cmd, a byte count). If this total transfer length is not met for some reason (either the GPIB-SCSI-A detected END or there was some sort of error), the GPIB-SCSI-A sends the remainder of the transfer length to the SCSI device, but the data consists of the byte specified by value. All data received prior to END or an error is properly transferred to the SCSI. The default value for this command is NULL, or 0.

If you enter **p**ad?, the GPIB-SCSI-A places the current value of **p**ad into the Command and Status Channel buffer followed by a <CR><LF>.

value represents an 8-bit unsigned number. Correct values range from 0 to 255. If a number that is too large is entered, or if there is no question mark and no value following the command, the GPIB-SCSI-A aborts the command with an EARG error indication.

The assignment made by this function remains in effect until you call **p**ad again or turn off the GPIB-SCSI-A.

See Also: *write* and *wrext.*

pad (continued)

Examples:

1.
```
ibwrt (gpibscsia, "pad?\n", 5);

/* Ask for the current pad byte setting of the
 * GPIB-SCSI-A.
 */

ibrd (gpibscsia, infobuf, 10);

/* Get the response from the GPIB-SCSI-A. */

      printf ("response:  %s\n", infobuf);

/* Display the data. */
```

   response: 0<CR><LF>

2.
```
ibwrt (gpibscsia, "pad 13\n", 7);

/* Set the pad byte to ASCII 13, the carriage
 * return character.
 */
```

rblks - Reassign Blocks

Type: SCSI function

Syntax: **rb**lks<CR>

Purpose: Use **rb**lks to command the GPIB-SCSI-A to process the Group 0 SCSI REASSIGN BLOCKS command.

Remarks: The GPIB-SCSI-A uses the following Command Descriptor Block to command the Target to process **rb**lks.

Bit / Byte	7	6	5	4	3	2	1	0
0	07							
1	LUN			00				
2	00							
3	00							
4	00							
5	VCB		00					

The LUN corresponds to the last value assigned with the **lun** command. The VCB corresponds to the last value assigned with the **vcb** command.

During the Data Out phase, the Initiator transfers a defect list that contains the logical block addresses to be reassigned. The Target reassigns the physical medium used for each logical block address in the list.

During the execution of this command, if the GPIB-SCSI-A encounters a phase which it does not expect, an EPHS error indication results. For a list of the expected phases, refer to the section titled *Handling of SCSI Phases in G Mode* in Chapter 6, *Programming in G Mode.*

rblks (continued)

Refer to your SCSI device documentation for the expected values in each byte of the Command Descriptor Block, the SCSI phases that the device creates, and the format of the defect list.

If anything follows the command, the GPIB-SCSI-A aborts the command with an EARG error indication.

Example:

```
ibwrt (gpibscsia, "rblks\n", 6);

/* Tell the GPIB-SCSI-A to complete a SCSI
 * REASSIGN BLOCKS command.
 */

ibwrt (scsidev,"\000\000\000\001\000\000\000
       \001, 8);

/* Send the defect list to the SCSI device over
 * the Data Channel.
 */
```

rcdia - Receive Diagnostic Results

Type: SCSI function

Syntax: **rcd**ia allocation length<CR>

Purpose: Use **rcd**ia to command the GPIB-SCSI-A to process the Group 0 SCSI RECEIVE DIAGNOSTIC RESULTS command.

Remarks: The GPIB-SCSI-A uses the following Command Descriptor Block to command the Target to process **rcd**ia. Notice how the parameter to the **rcd**ia command is used in the creation of the Command Descriptor Block.

Bit / Byte	7	6	5	4	3	2	1	0
0	1C							
1	LUN			00				
2	00							
3	Allocation Length (Most Significant Byte)							
4	Allocation Length (Least Significant Byte)							
5	VCB		00					

The Allocation Length in the Command Descriptor block above is given as a parameter to the **rcd**ia command. The LUN corresponds to the last value assigned with the **l**un command. The VCB corresponds to the last value assigned with the **v**cb command.

The Allocation Length is the number of bytes that the initiator has allocated for returned **rcd**ia data. An Allocation Length of 0 indicates that no data shall be transferred. This condition is not considered an error.

rcdia (continued)

Any other value indicates the maximum number of bytes that can be transferred. The Target terminates the Data In phase when Allocation Length bytes have been transferred or when all available **rcdia** data has been transferred to the Initiator, whichever is less.

During the execution of this command, if the GPIB-SCSI-A encounters a phase which it does not expect, an EPHS error indication results. For a list of the expected phases, refer to the section titled *Handling of SCSI Phases in G Mode* in Chapter 6, *Programming in G Mode.*

Refer to your SCSI device documentation for the expected values in each byte of the Command Descriptor Block, the SCSI phases that the device creates, and the format and meaning of the returned diagnostic data.

`allocation length` represents a 16-bit unsigned number. Correct values range from 0 to 65,535. If a number that is too large is entered, there is a syntax error in the number, or there is no number, the GPIB-SCSI-A aborts the command with an EARG error indication.

See Also: *sndia.*

rcdia (continued)

Example:

```
ibwrt (gpibscsia, "rcdia 100\n", 10);

/* Tell the GPIB-SCSI-A to complete a SCSI
 * RECEIVE DIAGNOSTIC RESULTS command.  The
 * allocation length is 100 bytes.
 */

ibrd (scsidev, rcdbuf, 100);

/* Get the data coming from the Data Channel
 */

processrcd (rcdbuf);

/* Process the buffer. */
```

rcnct - Reconnect the GPIB-SCSI-A to the SCSI

Type: SCSI Function

Syntax: **rc**nct<CR>

Purpose: Use **rc**nct to allow the GPIB-SCSI-A reconnect to the SCSI bus if the high-level commands performed by the GPIB-SCSI-A do not meet your needs and you need to perform low-level commands with your device which may include disconnection from the GPIB-SCSI-A.

Remarks: You must call this command within your low-level command sequence if the SCSI device to which you have issued a command has disconnected. After this command has been given to the GPIB-SCSI-A, you are not able to communicate with the GPIB-SCSI-A until the SCSI Target has reconnected, because the GPIB-SCSI-A goes into a state waiting for the reconnection.

This command automatically processes the Message In phase that normally follows a reconnection. Any message bytes that are received after the reconnection are placed into the Command and Status Channel buffer.

When this command completes and there is no error indicated, you can proceed with the low-level command sequence as the GPIB-SCSI-A now has been reconnected to the SCSI Target.

If there is anything following **rc**nct, the command aborts with EARG.

See Also: Appendix D, *Operation of the SCSI.*

rcnct (continued)

Example:

This example is an entire low-level command sequence. It performs a Group 0 SCSI WRITE command sequence that writes one block of data to a SCSI disk drive with a Target ID of 5 and a blocksize of 532 bytes. Most of this example does at a low-level what the high-level **write** command does automatically.

```
ibwrt (gpibscsia, "stat c n\n", 9);

/* Request the GPIB-SCSI-A to report numerical
 * status continuously.
 */

ibwrt (gpibscsia, "tid 5\n", 6);

/* Request to the GPIB-SCSI-A to communicate
 * with SCSI Target with ID of 5.
 */

ibwrt (gpibscsia, "blksz 532\n", 10);

/* Tell the GPIB-SCSI-A that the drive has
 * a blocksize of 532 bytes.  This information
 * can be found either in the documentation of
 * the SCSI disk drive or by executing the SCSI
 * MODE SENSE command either through low-level
 * command sequence or with the high-level
 * mdsns command provided by the GPIB-SCSI-A.
 */

ibwrt (gpibscsia, "pad 13\n", 7);

/* Request the GPIB-SCSI-A to pad data
 * transfers to the SCSI with the carriage
 * return character.
 */
```

rcnct (continued)

```
ibwrt (gpibscsia, "getscsi\n", 8);

/* Request the GPIB-SCSI-A to arbitrate for the
 * SCSI bus.
 */

ibrd (gpibscsia, miscbuf, 100);

/* Get the response from the GPIB-SCSI-A. */

get_stat(&ibstat,&gpiberr,&scsierr,miscbuf);

/* Call a routine to connect the character
 * strings representing numerical values to
 * binary data.
 */

if (ibstat < 0)

/* The status would be negative if any form of
 * error occurred with the GPIB or SCSI ports.
 */

      processerr (ibstat)

/* If error, go and process it. */

else
      {
      ibwrt (gpibscsia, "selwa\n", 6);

/* Continue with the operation.  At each step
 * in the process, check the status as you did
 * after getscsi above.  Because this does not
 * show anything new, it is not duplicated in
 * the remainder of this example.  selwa causes
 * the GPIB-SCSI-A to attempt selecting a SCSI
```

rcnct (continued)

```
 * device at ID 5 with the SCSI ATN* line
 * asserted.
 */

      ibwrt (gpibscsia, "msgout #hc0\n", 12);

/* After checking that the Target has gone into
 * the Message Out phase, give it an IDENTIFY
 * message that says you can support
 * disconnection/reconnection with this command
 * sequence.
 */

      ibwrt (gpibscsia, "cmd #ha, #h0, #h0, #h0,
            #h1, #h0\n", 33);

/* Build the SCSI Command Descriptor Block to
 * execute the Group 0 WRITE command.  Verify
 * that the Target you have selected is
 * in the Command phase before you issue this
 * command by analyzing the status returned
 * by the GPIB-SCSI-A.
 */

      ibwrt (gpibscsia, "msgin\n", 6);

/* After noticing that the SCSI Target is in
 * the Message In Phase, you need to get the
 * message byte(s). The Target may be in this
 * phase because it has just processed the
 * command and decided that it needs to
 * disconnect for a time consuming physical
 * head seek.
 */
```

rcnct (continued)

```
        ibrd (gpibscsia, miscbuf, 100);

    /* Get the message byte(s) from the Command
     * and Status Channel.
     */

        ibwrt (gpibscsia, "rcnct\n", 6);

    /* After analyzing the message byte received
     * in the above statement and noticing that
     * it is the SCSI DISCONNECT message (0x04),
     * call rcnct for the GPIB-SCSI-A to prepare
     * for reconnection.
     */

        ibwrt (gpibscsia, "dtout \n", 6);

    /* This alerts the GPIB-SCSI-A that you want to
     * send data from your GPIB port to the
     * selected SCSI Target.  Before executing
     * this command, verify that the Target is
     * now in the Data Out phase by analyzing
     * the status returned by the GPIB-SCSI-A.
     */

        ibwrt (scsidev, "Data to be stored.", 18);

    /* This line puts the data in quotes to the
     * Data Channel.  With the last byte sent,
     * the NI function call asserts the GPIB EOI*
     * signal, thus creating the END condition.
     * Therefore, after the GPIB-SCSI-A put out
     * the data in quotes, the GPIB-SCSI-A fills
     * the remainder of the transfer with the pad
     * byte.
     */
```

rcnct (continued)

```
        ibwrt (gpibscsia, "cmp\n", 4);

   /* After making sure that no errors occurred
    * on the last transfer and that the Target
    * is in the Status phase, call the cmp
    * command to allow the GPIB-SCSI-A to process
    * the Status and Message In phases.
    */
        }
```

rdbuf - Read Buffer

Type: SCSI function

Syntax: **rdb**uf buffer id, buffer offset, allocation length<CR>

Purpose: Use **rdb**uf to command the GPIB-SCSI-A to process the Group 1 SCSI READ BUFFER command.

Remarks: The GPIB-SCSI-A uses the following Command Descriptor Block to command the Target to process **rdb**uf. Notice how the parameters to the **rdb**uf command are used in the creation of the Command Descriptor Block.

Bit / Byte	7	6	5	4	3	2	1	0
0	3C							
1	LUN			02				
2	Buffer Id							
3	Buffer Offset (Most Significant Byte)							
4	Buffer Offset (Middle Significant Byte)							
5	Buffer Offset (Least Significant Byte)							
6	Allocation Length (Most Significant Byte)							
7	Allocation Length (Middle Significant Byte)							
8	Allocation Length (Least Significant Byte)							
9	VCB		00					

The Buffer Id, Buffer Offset, and Allocation Length in the Command Descriptor block are given as parameters to the **rdb**uf command. The LUN corresponds to the last value assigned with the **lun** command. The VCB corresponds to the last value assigned with the **vcb** command.

rdbuf (continued)

The Buffer Id notifies the Target as to which internal buffer it should use. The Buffer Offset indicates where in the buffer data should begin being transferred. The Allocation Length is the number of bytes that the Initiator has allocates for returned **rdb**uf data. An Allocation Length of 0 indicates that no **rdb**uf data is transferred. This condition is not considered an error. Any other value indicates the maximum number of bytes that are transferred. The Target terminates the Data In phase when Allocation Length bytes have transferred.

During the execution of this command, if the GPIB-SCSI-A encounters a phase which it does not expect, an EPHS error indication results. For a list of the expected phases, refer to the section titled *Handling of SCSI Phases in G Mode* in Chapter 6, *Programming in G Mode.*

Refer to the documentation of your SCSI device to see what values are expected in each byte of the Command Descriptor Block and what SCSI phases the device creates.

`buffer id` represents an 8-bit unsigned number. Correct values range from 0 to 255. `buffer offset` and `allocation length` represent 24-bit unsigned numbers. Correct values range from 0 to 16,777,216. If numbers that are too large are entered, there is a syntax error in a number, or there are no numbers, the GPIB-SCSI-A aborts the command with an EARG error indication.

See Also: *wrtbuf.*

rdbuf (continued)

Example:

```
ibwrt (gpibscsia, "rdbuf 1, 0, 500\n", 16);

/* Tell the GPIB-SCSI-A to complete a SCSI READ
 * BUFFER command.  The rest of the command is
 * requesting that the Target send 500 bytes of
 * data from the beginning of its first buffer.
 */

ibrd (scsidev, rdbbuf, 500);

/* Get the data from the Data Channel. */

processrdb (rdbbuf);

/* Process the buffer. */
```

rdcap - Read Capacity

Type: SCSI function

Syntax: **rdcap**<CR>

Purpose: Use **rdcap** to command the GPIB-SCSI-A to process the Group 1 SCSI READ CAPACITY command.

Remarks: The GPIB-SCSI-A uses the following Command Descriptor Block to command the Target to process **rdcap**.

Bit / Byte	7	6	5	4	3	2	1	0
0	25							
1	LUN			00				
2	00							
3	00							
4	00							
5	00							
6	00							
7	00							
8	00							
9	VCB			00				

The LUN corresponds to the last value assigned with the **lun** command. The VCB corresponds to the last value assigned with the **vcb** command.

rdcap (continued)

During the execution of this command, if the GPIB-SCSI-A encounters a phase which it does not expect, an EPHS error indication results. For a list of the expected phases, refer to the section titled *Handling of SCSI Phases in G Mode* in Chapter 6, *Programming in G Mode.*

The information returned in the Data In phase is the logical block address and block length, in bytes, of the last logical block of the specified logical unit.

Refer to your SCSI device documentation for the expected values in each byte of the Command Descriptor Block, the SCSI phases that the device creates, and the format and meaning of the returned READ CAPACITY data.

If there is anything following the **rdc**ap command, the GPIB-SCSI-A aborts the operation and indicates an EARG error.

Example:

```
ibwrt (gpibscsia, "rdcap\n", 6);

/* Tell the GPIB-SCSI-A to complete a SCSI
 * READ CAPACITY command.
 */

ibrd (scsidev, rdcbuf, 100);

/* Get the data from Data Channel. */

processrdc (rdcbuf);

/* Process the buffer. */
```

rdext - Read Extended

Type: SCSI function

Syntax: **rd**ext logical block address, transfer length<CR>
or
rdext?<CR>

Purpose: Use **rd**ext to command the GPIB-SCSI-A to process the Group 1 SCSI READ command.

Remarks: The GPIB-SCSI-A uses the following Command Descriptor Block to command the Target how to process **rd**ext. Notice how the parameters to the **rd**ext command are used in the creation of the Command Descriptor Block.

Bit / Byte	7	6	5	4	3	2	1	0
0	28							
1	LUN			00				
2	Logical Block Address (Most Significant Byte)							
3	Logical Block Address (Up.-Middle Significant Byte)							
4	Logical Block Address (Low-Middle Significant Byte)							
5	Logical Block Address (Least Significant Byte)							
6	00							
7	Transfer Length (Most Significant Byte)							
8	Transfer Length (Least Significant Byte)							
9	VCB			00				

The Logical Block Address and Transfer Length in the Command Descriptor block above are given as parameters to the **rd**ext command. The LUN corresponds to the last value assigned with the **lun** command. The VCB corresponds to the last value assigned with the **vcb** command.

rdext (continues)

The Logical Block Address notifies the Target as to where the data should be read from the device. The Transfer Length is the number of blocks that the Target must transfer during the Data In phase.

During the execution of this command, if the GPIB-SCSI-A encounters a phase which it did not expect, an EPHS error indication results. For a list of the expected phases, refer to the section titled *Handling of SCSI Phases in G Mode* in Chapter 6, *Programming in G Mode.*

Refer to your SCSI device documentation for expected values in each byte of the Command Descriptor Block and the SCSI phases that the device creates during the execution of this command.

If you enter **rd**`ext?`, the GPIB-SCSI-A places the most recent values for Logical Block Address and Transfer Length into the buffer of the Command and Status Channel followed by a <CR><LF>.

`logical block address` represents a 32-bit unsigned number. Correct values range from 0 to 4,294,967,296. `transfer length` represents a 16-bit unsigned number. Correct values range from 0 to 65,535. If numbers that are too large are entered, there is a syntax error in a number, or there are no numbers, the GPIB-SCSI-A aborts the command with an EARG error indication.

See Also: *blksz*, *dtin*, *dtout*, *read*, *wrext*, and *writ.*

rdext (continues)

Example:

This example causes the GPIB-SCSI-A to read eight blocks of data beginning at Logical Block Address 5,000 from the Target with a SCSI ID of 4, and blocksize of 512 bytes.

```
ibwrt (gpibscsia, "stat c n\n", 9);

/* Request the GPIB-SCSI-A to report numerical
 * status continuously.
 */

ibwrt (gpibscsia, "tid 4\n", 6);

/* Request to the GPIB-SCSI-A to communicate
 * with SCSI Target with id of 4.
 */

ibwrt (gpibscsia, "blksz 512\n", 10);

/* Tell the GPIB-SCSI-A that the drive has
 * a blocksize of 512 bytes.  This information
 * can be found either in the documentation of
 * the SCSI disk drive or by executing the SCSI
 * MODE SENSE command either through a low-level
 * command sequence or with the high-level
 * mdsns command provided by the GPIB-SCSI-A.
 */

ibwrt (gpibscsia, "rdext 5000, 8\n", 14);

/* Request the GPIB-SCSI-A to read data from the
 * SCSI Target at id 4.  This command
 * also tells the GPIB-SCSI-A that there are a
 * total of 4096 bytes (blksz * transfer length,
 * 8 * 512) transferred from the SCSI device to
 * the GPIB-SCSI-A.
 */
```

rdext (continues)

```
    ibrd (scsidev, databuf, 4096);

   /* Read the data from the SCSI device through
    * the Data Channel.
    */
```

rdfct - Read Defect Data

Type: SCSI function

Syntax: **rdf**ct configure byte, allocation length<CR>

Purpose: Use **rdf**ct to command the GPIB-SCSI-A to process the Group 1 SCSI command READ DEFECT DATA.

Remarks: The GPIB-SCSI-A uses the following Command Descriptor Block to command the Target to process **rdf**ct. Notice how the parameters to the **rdf**ct command are used in the creation of the Command Descriptor Block.

Bit / Byte	7	6	5	4	3	2	1	0
0	37							
1	LUN			00				
2	Configure Byte							
3	00							
4	00							
5	00							
6	00							
7	Allocation Length (Most Significant Byte)							
8	Allocation Length (Least Significant Byte)							
9	VCB			00				

The Configure Byte and Allocation Length in the Command Descriptor block above are given as parameters to the **rdf**ct command. The LUN corresponds to the last value assigned with the **lun** command. The VCB corresponds to the last value assigned with the **vcb** command.

rdfct (continued)

The Configure Byte notifies the Target as to the format of the defect data that the Initiator expects. The Allocation Length is the number of bytes that the Initiator has allocated for returned **rdf**ct data. An Allocation Length of 0 indicates that no **rdf**ct data shall be transferred. This condition is not considered an error. Any other value indicates the maximum number of bytes that shall be transferred. The Target terminates the Data In phase when Allocation Length bytes have been transferred or when all available **rdf**ct data have been transferred to the Initiator, whichever is less.

During the execution of this command, if the GPIB-SCSI-A encounters a phase which it does not expect, an EPHS error indication results. For a list of the expected phases, refer to Chapter 6, *Handling of SCSI Phases in G Mode*, *Commands That Require a Data In Phase.*

Refer to your SCSI device documentation for the expected values in each byte of the Command Descriptor Block, the SCSI phases that the device creates, and the format and meaning of the returned defect data.

configure byte represents an 8-bit unsigned number. Correct values range from 0 to 255. Allocation Length represents a 16-bit unsigned number. Correct values range from 0 to 65,535. If numbers that are too large are entered, there is a syntax error in a number, or there are no numbers, the GPIB-SCSI-A aborts the command with an EARG error indication.

See Also: *format.*

rdfct (continued)

Example:

```
ibwrt (gpibscsia, "rdfct #h18, 500\n", 16);

/* Tell the GPIB-SCSI-A to complete a SCSI READ
 * DEFECT DATA command.  The configure byte is
 * set to 18 hex which has a particular meaning
 * to a device.  The allocation length is 500
 * bytes.
 */

ibrd (scsidev, rdfbuf, 500);

/* Get the data from the Data Channel. */

processdfct (rdfbuf);

/* Process the buffer. */
```

read - Read

Type: SCSI function

Syntax: `read logical block address, transfer length<CR>`
or
`read?<CR>`

Purpose: Use `read` to command the GPIB-SCSI-A to process the Group 0 SCSI READ command.

Remarks: The GPIB-SCSI-A uses the following Command Descriptor Block to command the Target to process `read`. Notice how the parameters to the `read` command are used in the creation of the Command Descriptor Block.

Bit / Byte	7	6	5	4	3	2	1	0
0	08							
1	LUN			Logical Block (Upper 5 bits)				
2	Logical Block Address (Middle Significant Byte)							
3	Logical Block Address (Least Significant Byte)							
4	Transfer Length							
5	VCB		00					

The Logical Block Address and Transfer Length in the Command Descriptor block above are given as parameters to the `read` command. The LUN corresponds to the last value assigned with the `lun` command. The VCB corresponds to the last value assigned with the `vcb` command.

The Logical Block Address notifies the Target where the data should be read from the device. The Transfer Length is the number of blocks that the Target should transfer during the Data In phase. A zero represents 256 blocks.

read (continued)

During the execution of this command, if the GPIB-SCSI-A encounters a phase which it did not expect, an EPHS error indication results. For a list of the expected phases, refer to the section titled *Handling of SCSI Phases in G Mode* in Chapter 6, *Programming in G Mode.*

Refer to your SCSI device documentation for the expected values in each byte of the Command Descriptor Block and the SCSI phases that the device creates during the execution of this command.

If you enter `read?`, the GPIB-SCSI-A places the last used values for Logical Block Address and Transfer Length into the Command and Status Channel's buffer followed by a <CR><LF>.

`logical block address` represents a 21-bit unsigned number. Correct values range from 0 to 2,097,152. `transfer length` represents an 8-bit unsigned number. Correct values range from 0 to 255. If numbers that are too large are entered, there is a syntax error in a number, or there are no numbers, the GPIB-SCSI-A aborts the command with an EARG error indication.

See Also: *blksz*, *rdext*, *dtin*, *dtout*, *wrext*, and *write.*

read (continued)

Example:

This example causes the GPIB-SCSI-A to read 10 blocks of data beginning at Logical Block Address 100 from the Target with a SCSI id of 4 and blocksize of 512 bytes.

```
ibwrt (gpibscsia, "stat c n\n", 9);

/* Request the GPIB-SCSI-A to report numerical
 * status continuously.
 */

ibwrt (gpibscsia, "tid 4\n", 6);

/* Request to the GPIB-SCSI-A to communicate
 * with SCSI Target with ID of 4.
 */

ibwrt (gpibscsia, "blksz 512\n", 10);

/* Tell the GPIB-SCSI-A that the drive has
 * a blocksize of 512 bytes.  This information
 * can be found either in the documentation of
 * the SCSI disk drive or by executing the SCSI
 * MODE SENSE command either through a low-level
 * command sequence or with the high-level mdsns
 * command provided by the GPIB-SCSI-A.
 */

ibwrt (gpibscsia, "read 100, 10\n", 13);

/* Request the GPIB-SCSI-A to read data
 * from the SCSI Target at ID 4.  This command
 * also tells the GPIB-SCSI-A that there are a
 * total of 5120 bytes (blksz * transfer length,
 * 10 * 512) transferred from the SCSI device to
 * the GPIB-SCSI-A. Therefore, that is the least
 * you are reading from the GPIB-SCSI-A
 * over the GPIB.
 */
```

read (continued)

```
ibrd (scsidev, databuf, 5120);

/* Read the data from the SCSI device
 * through Data Channel.
 */
```

rewind - Rewind

Type: SCSI function

Syntax: **rew**ind<CR>

Purpose: Use **rew**ind to command the GPIB-SCSI-A to process the Group 0 SCSI REWIND command.

Remarks: The GPIB-SCSI-A uses the following Command Descriptor Block to command the Target to process **rew**ind.

Bit / Byte	7	6	5	4	3	2	1	0
0	01							
1	LUN			00				
2	00							
3	00							
4	00							
5	VCB		00					

The LUN corresponds to the last value assigned with the **lun** command. The VCB corresponds to the last value assigned with the **vcb** command.

During the execution of this command, if the GPIB-SCSI-A encounters a phase which it does not expect, an EPHS error indication results. For a list of the expected phases, refer to the section titled *Handling of SCSI Phases in G Mode* in Chapter 6, *Programming in G Mode.*

Refer to your SCSI device documentation for expected values in each byte of the Command Descriptor Block as well as the SCSI phases the device creates.

If there is anything following the command, the GPIB-SCSI-A aborts the command with an EARG error indication.

rewind (continued)

Example:

```
ibwrt (gpibscsia, "rewind\n", 7);

/* Tell the GPIB-SCSI-A to complete a SCSI
 * REWIND command.
 */
```

rlseu - Release Logical Unit

Type: SCSI function

Syntax: `rlseu<CR>`

Purpose: Use `rlseu` to command the GPIB-SCSI-A to process the Group 0 SCSI RELEASE UNIT command.

Remarks: The GPIB-SCSI-A uses the following Command Descriptor Block to command the Target to process `rlseu`.

Bit / Byte	7	6	5	4	3	2	1	0
0	17							
1	LUN			00				
2	00							
3	00							
4	00							
5	VCB			00				

The LUN corresponds to the last value assigned with the `lun` command. The VCB corresponds to the last value assigned with the `vcb` command.

During the execution of this command, if the GPIB-SCSI-A encounters a phase which it does not expect, an EPHS error indication results. For a list of the expected phases, refer to the section titled *Handling of SCSI Phases in G Mode* in Chapter 6, *Programming in G Mode.*

Refer to your SCSI device documentation for expected values in each byte of the Command Descriptor Block as well as the SCSI phases the device creates.

If there is anything following the command, the GPIB-SCSI-A aborts the command with an EARG error indication.

See Also: *rsrvu.*

rlseu (continued)

Example:

```
ibwrt (gpibscsia, "rlseu\n", 6);

/* Tell the GPIB-SCSI-A to complete a SCSI
 * RELEASE UNIT command. This causes the Target
 * to terminate all logical unit and extent
 * reservations that are active from the
 * GPIB-SCSI-A.
 */
```

rqsns - Request Sense

Type: SCSI function

Syntax: **rq**sns allocation length<CR>

Purpose: Use **rq**sns to command the GPIB-SCSI-A to process the Group 0 SCSI REQUEST SENSE command.

Remarks: The GPIB-SCSI-A uses the following Command Descriptor Block to command the Target to process **rq**sns. Notice how the parameter to the **rq**sns command is used in the creation of the Command Descriptor Block.

Bit / Byte	7	6	5	4	3	2	1	0
0	03							
1	LUN			00				
2	00							
3	00							
4	Allocation Length							
5	VCB		00					

The Allocation Length in the Command Descriptor Block above is given as a parameter to the **rq**sns command. The LUN corresponds to the last value assigned with the **l**un command. The VCB corresponds to the last value assigned with the **v**cb command.

The Allocation Length is the number of bytes that the Initiator has allocated for returned **rq**sns data. An Allocation Length of 0 indicates that no **rq**sns data is transferred. This condition is not considered an error. Any other value indicates the maximum number of bytes that are transferred. The Target should terminate the Data In phase when Allocation Length bytes have transferred or when all available **rq**sns data have transferred to the Initiator, whichever is less.

rqsns (continued)

During the execution of this command, if the GPIB-SCSI-A encounters a phase which it does not expect, an EPHS error indication results. For a list of the expected phases, refer to the section titled *Handling of SCSI Phases in G Mode* in Chapter 6, *Programming in G Mode.*

Refer to your SCSI device documentation for expected values in each byte of the Command Descriptor Block as well as the SCSI phases the device creates, and the format and meaning of the returned sense data.

`allocation length` represents an 8-bit unsigned number. Correct values range from 0 to 255. If a number that is too large is entered, there is a syntax error in the number, or there is no number, the GPIB-SCSI-A aborts the command with an EARG error indication.

See Also: Appendix D, *Operation of the SCSI.*

Example:

```
ibwrt (gpibscsia, "rqsns 100\n", 10);

/* Tell the GPIB-SCSI-A to complete a SCSI
 * REQUEST SENSE command.  The allocation
 * length is 100 bytes
 */

ibrd (scsidev, rqsbuf, 100);

/* Get the data from the Data Channel. */

processsns (allocbuf);

/* Process the buffer. */
```

rsrvu - Reserve Logical Unit

Type: SCSI function

Syntax: **rsrvu**<CR>

Purpose: Use **rsrvu** to command the GPIB-SCSI-A to process the Group 0 SCSI RESERVE UNIT command.

Remarks: The GPIB-SCSI-A uses the following Command Descriptor Block to command the Target to process **rsrvu**.

Bit / Byte	7	6	5	4	3	2	1	0
0	16							
1	LUN			00				
2	00							
3	00							
4	00							
5	VCB		00					

The LUN corresponds to the last value assigned with the **lun** command. The VCB corresponds to the last value assigned with the **vcb** command.

During the execution of this command, if the GPIB-SCSI-A encounters a phase which it does not expect, an EPHS error indication results. For a list of the expected phases, refer to the section titled *Handling of SCSI Phases in G Mode* in Chapter 6, *Programming in G Mode.*

Refer to your SCSI device documentation for expected values in each byte of the Command Descriptor Block as well as the SCSI phases the device creates.

rsrvu (continued)

If there is anything following the command, the GPIB-SCSI-A aborts the command with an EARG error indication.

See Also: *rlseu.*

Example:

```
ibwrt (gpibscsia, "rsrvu\n", 6);

/* Tell the GPIB-SCSI-A to complete a SCSI
 * RESERVE UNIT command. This causes the Target
 * to reserve the entire logical unit for the
 * exclusive use of the GPIB-SCSI-A.
 */
```

rst - Reset SCSI Bus

Type: SCSI Function

Syntax: **rst**<CR>

Purpose: Use **rst** if a device on the SCSI bus is not acting as expected and, therefore, is preventing other SCSI activity from occurring.

Remarks: This command causes the GPIB-SCSI-A to assert the SCSI RST* signal for approximately 100 µsec. The assertion of RST* for 25 µsec causes all devices on the SCSI to go to a known, reset state.

If there is anything following **rst**, the command aborts and returns an EARG indication.

See Also: Appendix D, *Operation of the SCSI.*

Example:

```
ibwrt (gpibscsia, "rst\n", 6);

/* The GPIB-SCSI-A asserts the SCSI RST*
 * signal for a time during which all SCSI
 * devices should go to a known, reset state.
 */
```

selwa - Select a SCSI Target With SCSI ATN* Asserted

Type: SCSI Function

Syntax: **selwa**<CR>

Purpose: Use **selwa** to select a Target on the SCSI bus if the high-level commands performed by the GPIB-SCSI-A do not meet your needs and you must perform low-level commands with your device. This command also alerts the Target that the Initiator has a message byte ready for the Target by selecting the Target with the SCSI ATN* signal active.

Remarks: This is the second command that you must use in your low-level command pattern if the high-level commands offered by the GPIB-SCSI-A do not work with your SCSI device. This command performs the Selection phase for the SCSI bus.

Because the SCSI ATN* line is asserted during the Selection phase, this signals to the Target that the GPIB-SCSI-A as an Initiator has some message to send to the Target. The Target may then go into the Message Out phase and any information transferred across the SCSI is treated as a message.

If the Target cannot respond to the ATN* signal-that is, the Target does not support the Message Out phase, the Target ignores the ATN* signal. If the Target does not go into the Message Out phase and retrieve the byte from the Initiator, the GPIB-SCSI-A continues on and does not hang.

The SCSI specification states that it is at the discretion of the Target as to when a Message Out phase occurs. That is, the Target does not necessarily have to go into the Message Out phase immediately, but can wait until a later time. In order for the high level SCSI commands offered by the GPIB-SCSI-A to work, the Target must go into the Message Out phase immediately after the Selection phase and before the Command phase.

selwa (continued)

If there is not a SCSI device whose ID is equal to that indicated with the **tid** command, this command fails to select a Target. In this event, the GPIB-SCSI-A aborts the command and returns the ESEL error indication.

If there is anything following **selwa**, the command aborts and returns an EARG indication.

If this command completes and there is no error indicated, you can proceed with the low-level command sequence as the GPIB-SCSI-A now has selected the proper Target.

See Also: *selwo*, and Appendix D, *Operation of the SCSI.*

Example:

```
ibwrt (gpibscsia, "selwa\n", 6);

/* Select a desired Target with the SCSI ATN*
 * signal asserted for an operation.
 */
```

selwo - Select a SCSI Target Without SCSI ATN* Asserted

Type: SCSI Function

Syntax: **se**lwo<CR>

Purpose: Use **se**lwo to select a Target on the SCSI bus if the high-level commands performed by the GPIB-SCSI-A do not meet your needs and you need to perform low-level commands with your device.

Remarks: This is the second command that you must use in your low-level command sequence if the high-level commands offered by the GPIB-SCSI-A do not work with your SCSI device. This command performs the Selection phase for the SCSI bus.

Because the GPIB-SCSI-A does not assert the ATN* line when selecting a Target, the Initiator indicates that it has no message to send to the Target.

If there is not a SCSI device whose ID is equal to that indicated with the **ti**d command, this command fails to select a Target. In this event, the GPIB-SCSI-A aborts the command and returns the ESEL error indication.

If there is anything following **se**lwo, the command aborts and returns an EARG indication.

If this command completes and there is no error indicated, you can proceed with the low-level command sequence as the GPIB-SCSI-A now has selected the proper Target.

See Also: *selwa*, and Appendix D, *Operation of the SCSI.*

Example:

```
ibwrt (gpibscsia, "selwo\n", 6);

/* Select a desired SCSI Target for some
 * operation.
 */
```

sndia - Send Diagnostic

Type: SCSI function

Syntax: **sn**dia value[, parameter list length]<CR>

Purpose: Use **sn**dia to command the GPIB-SCSI-A to process the Group 0 SCSI SEND DIAGNOSTIC command.

Remarks: The GPIB-SCSI-A uses the following Command Descriptor Block to command the Target to process **sn**dia. Notice how the parameters to the **sn**dia command are used in the creation of the Command Descriptor Block.

Bit / Byte	7	6	5	4	3	2	1	0
0	1D							
1	LUN			04 or [00]				
2	00							
3	00 or [Parameter List Length Most Significant Byte]							
4	00 or [Parameter List Length Least Significant Byte]							
5	VCB		00					

The values in the above Command Descriptor Block that are in brackets, [ ], are optional and are placed into the Command Descriptor Block only if the value parameter is zero. The LUN corresponds to the last value assigned with the **l**un command. The VCB corresponds to the last value assigned with the **vc**b command.

During the execution of this command, if the GPIB-SCSI-A encounters a phase which it does not expect, an EPHS error indication results. For a list of the expected phases, refer to Chapter 6, *Programming in G Mode*.

sndia (continued)

Refer to your SCSI device documentation for the expected values in each byte of the Command Descriptor Block, the SCSI phases that the device creates, and the format of the necessary parameter list.

`value` must follow the **`sn`**`dia` command and is an 8-bit unsigned number. If `value` is zero, the optional `parameter list length` must be included. If the `parameter list length` is not included, the GPIB-SCSI-A aborts the command with an EARG indication. If `value` is non-zero, the GPIB-SCSI-A commands the SCSI Target to perform its internal self-test. In this case, the `parameter list length` should not be specified, and if it is, the GPIB-SCSI-A aborts the command with an EARG indication.

See Also: *rcdia.*

Examples:

1.
```
ibwrt (gpibscsia, "sndia 1\n", 8);
```

```
/* Tell the GPIB-SCSI-A to complete a SCSI SEND
 * DIAGNOSTIC command. This causes the Target
 * to perform its self test. If the
 * documentation for your Target states that
 * you must use the RECEIVE DIAGNOSTIC command
 * to obtain the results of the test, then this
 * command should be followed by the RECEIVE
 * DIAGNOSTIC command and then an analysis of
 * the data.  However, some devices just
 * perform their test and return the results in
 * the Status Phase byte.
 */
```

sndia (continued)

2. `ibwrt (gpibscsia, "sndia 0, #h1\n", 13);`

```
/* Tell the GPIB-SCSI-A to complete a SCSI SEND
 * DIAGNOSTIC command.  Due to the parameters
 * specified, the GPIB-SCSI-A expects the
 * Target to go into a Data Out phase at a
 * proper point to send a parameter list.
 */

ibwrt (scsidev, "\001", 1);

/* Send out the parameter list to the Target.
 * This is device specific.  The byte in the
 * above statement is arbitrary and is included
 * for example purposes only.
 */
```

space - Space

Type: SCSI function

Syntax: **sp**ace code, count

Purpose: Use **sp**ace to command the GPIB-SCSI-A to process the Group 0 SCSI SPACE command.

Remarks: The GPIB-SCSI-A uses the following Command Descriptor Block to command the Target to process **sp**ace. Notice how the parameters to the **sp**ace command are used in the creation of the Command Descriptor Block.

Bit / Byte	7	6	5	4	3	2	1	0
0	11							
1	LUN						Code	
2	Count (Most Significant Byte)							
3	Count (Middle Significant Byte)							
4	Count (Least Significant Byte)							
5	VCB		00					

The Count and Code in the Command Descriptor Block are given as parameters to the **sp**ace command. The LUN corresponds to the last value assigned with the **l**un command. The VCB corresponds to the last value assigned with the **v**cb command.

During the execution of this command, if the GPIB-SCSI-A encounters a phase which it does not expect, an EPHS error indication results. For a list of the expected phases, refer to the section titled *Handling of SCSI Phases in G Mode* in Chapter 6, *Programming in G Mode.*

Refer to your SCSI device documentation for the expected values in each byte of the Command Descriptor Block and the SCSI phases that the device creates.

space (continued)

Code represents a 2-bit unsigned number. Correct values range from 0 to 3. Count represents a 24-bit signed number. Correct values range from -8,388,608 to +8,388,607.

If numbers that are too large are entered, there is a syntax error in a number, or there are no numbers, the GPIB-SCSI-A aborts the command with an EARG error indication.

See Also: *wfmks.*

Examples:

1.
```
ibwrt (gpibscsia, "space 1, 10\n", 12);

/* Tell the GPIB-SCSI-A to complete a SCSI
 * SPACE command.  The rest of the command
 * further defines that the Target should
 * space forward 10 file marks.
 */
```

2.
```
ibwrt (gpibscsia, "space 0, -20\n", 13);

/* Tell the GPIB-SCSI-A to complete a SCSI
 * SPACE command.  The rest of the command
 * further defines that the Target should
 * space backward 20 file records.
 */
```

srqen - Enable/Disable Setting of SRQ

Type: GPIB Configuration function

Syntax: `srqen mask<CR>`
or
`srqen?<CR>`

Purpose: Use `srqen` to allow the GPIB-SCSI-A to assert SRQ under the conditions described in Table 7-2.

Remarks: When the argument `mask` is 0, the GPIB-SCSI-A never asserts SRQ. When the argument `mask` is > 0, the GPIB-SCSI-A asserts SRQ under the conditions represented by each bit in the `mask`. The SRQ `mask` bits are listed in Table 7-2.

Table 7-2. SRQ Mask Bits

Bit	Hex Value	Decimal Value	Mnemonic	Description
0	1	1	-	Not used
1	2	2	-	Not used
2	4	4	-	Not used
3	8	8	DCR	Indicates that the data channel is ready to transfer data to or from the SCSI. Essentially, this bit indicates whether or not the selected SCSI Target has entered the expected Data In or Data Out phases.
4	10	16	RDY	Indicates that the GPIB-SCSI-A is now in a state where it can communicate via the Command and Status Channel.
5	20	32	-	Not used

(continues)

srqen (continued)

Table 7-2. SRQ Mask Bits (continued)

Bit	Hex Value	Decimal Value	Mnemonic	Description
6	40	64	-	Not used
7	80	128	ERR	An error condition occurred with the GPIB-SCSI-A. To further define the error, use the `stat` function.

To determine the `mask` value you want, add up the hex values of each of the conditions on which you want SRQ to be asserted.

The default mask for **`srqen`** is zero – that is, SRQ never asserts.

If you enter **`srqen`**`?`, the GPIB-SCSI-A places the current value of **`srqen`** into the Command and Status Channel buffer followed by a <CR><LF>.

If `mask` that you have entered is not a valid mask, or if there is no question mark and no value, the GPIB-SCSI-A aborts the command with an EARG error indication.

The assignment made by this function remains in effect until you call **`srqen`** again or turn off the GPIB-SCSI-A.

See Also: *Serial Poll* section in Chapter 6, *Programming in G Mode,* and Appendix E, *Parallel Polling.*

srqen (continued)

Examples:

1.
```
ibwrt (gpibscsia, "srqen?\n", 7);

/* Ask for current srqen mask setting. */

ibrd (gpibscsia, infobuf, 10);

/* Get the response from the GPIB-SCSI-A. */

printf ("response:  %s\n", infobuf);

/* Display the data. */
```

   response: 0<CR><LF>

2.
```
ibwrt (gpibscsia, "srqen #h80\n", 11);

/* Indicate that you want a mask of hex 80
 * which allows the GPIB-SCSI-A to assert
 * SRQ when any error occurs.
 */
```

stat - Return GPIB-SCSI-A Status

Type: General Use function

Syntax:
```
stat [[c] n]<CR>
    or
stat [c] s<CR>
    or
stat [c] b<CR>
    or
stat [c] n s b<CR>
```

Purpose: Use `stat` to obtain the status of the GPIB-SCSI-A to see if certain conditions are currently present. You use `stat` most often to see if the previous operation resulted in an error.

Remarks: The GPIB-SCSI-A returns status information to you in a form depending on the mode, or combination of modes, you selected. `n` indicates that the status information is returned as numeric strings. `s` indicates that the status information is returned in symbolic format – that is, as mnemonic strings. `b` indicates that the status information is returned as four bytes of binary data. `c` indicates that the status is returned after each programming message, eliminating the need to call `stat` repetitively.

Normally, you use `s` (the symbolic format only) when you are debugging your code and you want to print the mnemonic for easy reference.

The status information returned by the GPIB-SCSI-A contains four pieces of information:

- The GPIB-SCSI-A status
- A GPIB error code
- A SCSI error code

The GPIB-SCSI-A returns a <CR><LF> following each piece of the response, except for binary responses.

stat (continued)

Status represents a combination of GPIB-SCSI-A conditions. Status is stored as a 16-bit integer in the GPIB-SCSI-A. Each bit in the integer represents a single condition. A bit value of 1 indicates that the corresponding condition is in effect. A bit value of 0 indicates that the condition is not in effect. Because more than one GPIB-SCSI-A condition can exist at one time, more than one bit can be set in status. The highest order bit of status, also called the sign bit, is set when the GPIB-SCSI-A detects either a GPIB error or a SCSI error. Consequently, when status is negative, an error condition exists. When status is positive, no error condition exists.

GPIB error represents a single GPIB error condition present.

SCSI error represents a single SCSI error condition present.

Table 7-3 contains a list of the GPIB-SCSI-A status conditions, along with their numeric value, bit value, and a short description of each.

Table 7-3. GPIB-SCSI-A Status Conditions

Numeric Value (n)	Status	Description	Bit
-32768	ERR	Error detected	15
16384	-	Reserved	14
8192	-	Reserved	13
4096	-	Reserved	12
2048	-	Reserved	11
1024	-	Reserved	10

(continues)

stat (continued)

Table 7-3. GPIB-SCSI-A Status Conditions (continued)

Numeric Value (n)	Status	Description	Bit
512	-	Reserved	9
256	CMPL	Operation completed	8
128	MGIN	Message In phase	7
64	MOUT	Message Out phase	6
32	BSFR	Bus Free phase (BSY* not asserted)	5
16	SLCT	Selection phase	4
8	STAT	Status phase	3
4	COMD	Command phase	2
2	DTIN	Data In phase	1
1	DOUT	Data Out phase	0

stat (continued)

Table 7-4 contains a list of the GPIB error conditions, along with their numeric value and a short description of each.

Table 7-4. GPIB Error Conditions

Numeric Value (n)	Symbolic Value (s)	Description
0	NGER	No GPIB error condition to report
1	-	Reserved
2	ENOL	Write detected no listeners
3	-	Reserved
4	EARG	Invalid argument or arguments
5	-	Reserved
6	-	Reserved
7-16	-	Reserved
17	ECMD	Unrecognized command

stat (continued)

Table 7-5 contains a list of the SCSI error conditions, along with their numeric value and a short description of each.

Table 7-5. SCSI Error Conditions

Numeric Value (n)	Symbolic Value (s)	Description
0	NSER	No SCSI error condition to report
1	EARB	SCSI Arbitration failure occurred
2	ESEL	SCSI Selection failure occurred
3	-	Reserved
4	EPHS	SCSI Phase mismatch occurred
5	ECER	Catastrophic Error Condition. Caused by the SCSI Target releasing the SCSI BSY* signal without first notifying the GPIB-SCSI-A of its intention to disconnect.
6	EPAR	SCSI parity error occurred. No steps were taken by the GPIB-SCSI-A, but the data read from the SCSI device into the GPIB may be corrupt.
128 - 135 (80 - 87 hex)	TST0 - TST7	Error detected on a Test Unit Ready command issued to one of the SCSI Target IDs specified in the **a**`utotst` command.

A detailed description of the conditions under which each bit in status is set or cleared as well as what causes a GPIB error

stat (continued)

or SCSI error can be found in Appendix B, *Status and Message Information.*

The GPIB-SCSI-A updates status at the end of each programming message. It updates GPIB error and SCSI error whenever a new error occurs.

If you call **stat** with all modes (n, s, and b) specified, the numeric status is always returned first followed by the symbolic status, followed by the binary status.

If you call **stat** without an argument, continuous status reporting is disabled.

See Also: *rqsns* and Appendix B, *Status and Message Information.*

Examples:

1.
```
ibwrt (gpibscsia, "stat n\n", 7);

/* Request the GPIB-SCSI-A to send us numeric
 * status. */

ibrd (gpibscsia, stbuf, 100);

/* Read the status back into a buffer until you
 * receive END from the GPIB-SCSI-A.
 */

get_stat (&ibstat, &gpiberr, &scsierr, stbuf);

/* Call a routine that takes the component
 * strings of numbers and converts them to
 * numeric values which are returned to the
 * calling program.
 */
```

stat (continued)

```
   if (ibstat < 0)

   processerr (ibstat)

   /* If error, go and process it. */

2. ibwrt (gpibscsia, "stat c n\n", 9);

   /* Request GPIB-SCSI-A to send numeric status.
    * You are also enabling continuous reporting.
    */

   ibrd (gpibscsia, stbuf, 100);

   /* Read status information. */

   printf ("status is %s", stbuf);

   /* Print the information. */

3. ibwrt (gpibscsia, "stat c s\n", 9);

   /* Request GPIB-SCSI-A to send symbolic status.
    * You are also enabling continuous reporting.
    */

   ibrd (gpibscsia, stbuf, 100);

   /* Read status information until END. */

   printf ("status is: %s", stbuf);

   /* Print the information. */

   status is: CMPL, BSFR <CR><LF>
   NGER <CR><LF>
   NSER <CR><LF>
```

tid - Set SCSI Id of Target Device

Type: SCSI Configuration function

Syntax: **tid** value<CR>
or
tid?<CR>

Purpose: Use **tid** to change the ID of the SCSI device that the GPIB-SCSI-A attempts to select for any of its high-level commands or with **selwo** or **selwa**.

Remarks: This command is in effect for any of the high-level GPIB-SCSI-A commands that communicate with the SCSI and when using the low-level **selwo** or **selwa** commands. When the GPIB-SCSI-A is issued one of the high-level SCSI commands, the SCSI Target that is to carry out the operation must first be selected by the GPIB-SCSI-A. By using this command, the GPIB-SCSI-A communicates with any SCSI device with a unique identification. The default value for **tid** is 2.

If you enter **tid**?, the GPIB-SCSI-A places the current value of **tid** into the Command and Status Channel buffer followed by a <CR><LF>.

value represents a 3-bit unsigned number. Correct values range from 0 to 7. If a number that is too large is entered, or if there is no question mark and no value following the command, the GPIB-SCSI-A aborts the command with an EARG error indication.

The assignment made by this function remains in effect until you call **tid** again or turn off the GPIB-SCSI-A.

See Also: Appendix D, *Operation of the SCSI.*

tid (continued)

Examples:

1.
```
ibwrt (gpibscsia, "tid?\n", 5);
/* Ask for the current tid setting. */
ibrd (gpibscsia, infobuf, 10);
/* Get the response from the GPIB-SCSI-A. */
printf ("response:  %s\n", infobuf);
/* Display the data. */
```
response: 0<CR><LF>

2.
```
ibwrt (gpibscsia, "tid 3\n", 6);
/* Set the tid value to 3. */
```

tstur - Test Unit Ready

Type: SCSI function

Syntax: `tstur`<CR>

Purpose: Use `tstur` to command the GPIB-SCSI-A to process the Group 0 SCSI TEST UNIT READY command.

Remarks: The GPIB-SCSI-A uses the following Command Descriptor Block to command the Target to process `tstur`.

Bit / Byte	7	6	5	4	3	2	1	0
0	00							
1	LUN			00				
2	00							
3	00							
4	00							
5	VCB		00					

The LUN corresponds to the last value assigned with the `lun` command. The VCB corresponds to the last value assigned with the `vcb` command.

During the execution of this command, if the GPIB-SCSI-A encounters a phase which it does not expect, an EPHS error indication results. For a list of the expected phases, refer to the section titled *Handling of SCSI Phases in G Mode* in Chapter 6, *Programming in G Mode.*

Refer to your SCSI device documentation for the expected values in each byte of the Command Descriptor Block and the SCSI phases that the device creates.

If there is anything following the command, the GPIB-SCSI-A aborts the command with an EARG error indication.

tstur (continued)

Example:

```
ibwrt (gpibscsia, "tstur\n", 6);

/* Tell the GPIB-SCSI-A to complete a SCSI TEST
 * UNIT READY command.  This is useful if you
 * want to see if the device is ready to
 * operate.  This is not, however, a request
 * for a self test.
 */
```

vcb - Set Vendor Unique Control Byte Bits

Type: SCSI Configuration function

Syntax: **vcb** value<CR>
or
vcb?<CR>

Purpose: Use **vcb** to change the value that the GPIB-SCSI-A uses in the upper two bits of the Control Byte portion of any Command Descriptor Block created for communication with any SCSI device.

Remarks: This command is in effect for any of the high level GPIB-SCSI-A commands that communicate with the SCSI. This command is only used if the manufacturer of your SCSI device has indicated that the device expects some value in the two bits in the Control Byte of the command descriptor block of each command. For more information on the Control Byte or the command descriptor blocks, refer to Appendix D, *Operation of the SCSI.* The default value for **vcb** is 0.

If you enter **vcb?**, the GPIB-SCSI-A places the current value of **vcb** into the Command and Status Channel buffer followed by a <CR><LF>.

value represents a 2-bit unsigned number. Correct values are from 0 to 3. If a number that is too large is entered, or if there is no question mark and no value following the command, the GPIB-SCSI-A aborts the command with an EARG error indication.

The assignment made by this function remains in effect until you call **vcb** again or turn off the GPIB-SCSI-A.

See Also: Appendix D, *Operation of the SCSI.*

vcb (continued)

Examples:

1.
```
ibwrt (gpibscsia, "vcb?\n", 5);
/* Ask for the current vcb setting.*/
ibrd (gpibscsia, infobuf, 1000);
/* Get the response from the GPIB-SCSI-A. */
printf ("response:  %s\n", infobuf);
/* Display the data. */
```
response: 0<CR><LF>

2.
```
ibwrt (gpibscsia, "vcb 3\n", 6);
/* Set the vcb value to 3. */
```

wfmks - Write Filemarks

Type: SCSI function

Syntax: **wf**mks filemarks<CR>

Purpose: Use **wf**mks to command the GPIB-SCSI-A to process the Group 0 SCSI WRITE FILEMARKS command.

Remarks: The GPIB-SCSI-A uses the following Command Descriptor Block to command the Target to process **wf**mks. Notice how the parameter to the **wf**mks command is used in the creation of the Command Descriptor Block.

Bit / Byte	7	6	5	4	3	2	1	0
0	10							
1	LUN			00				
2	Number of Filemarks (Most Significant Byte)							
3	Number of Filemarks (Middle Significant Byte)							
4	Number of Filemarks (Least Significant Byte)							
5	VCB		00					

The Number of Filemarks in the above Command Descriptor Block is given as a parameter to the **wf**mks command. The LUN corresponds to the last value assigned with the **l**un command. The VCB corresponds to the last value assigned with the **v**cb command.

During the execution of this command, if the GPIB-SCSI-A encounters a phase which it does not expect, an EPHS error indication results. For a list of the expected phases, refer to the section titled *Handling of SCSI Phases in G Mode* in Chapter 6, *Programming in G Mode.*

Refer to your SCSI device documentation for expected values in each byte of the Command Descriptor Block and the SCSI

wfmks (continued)

phases that the device creates during the execution of this command.

`filemarks` represents a 24-bit unsigned number. Correct values range from 0 to 16, 777, 216. If a number that is too large is entered, there is a syntax error in the number, or there is no number, the GPIB-SCSI-A aborts the command with an EARG error indication.

Example:

```
ibwrt (gpibscsia, "wfmks 1\n", 8);

/* Tell the GPIB-SCSI-A to complete a SCSI
 * WRITE FILEMARKS command.
 */
```

wrext - Write Extended

Type: SCSI function

Syntax: `wrext logical block address, transfer length<CR>`
or
`wrext?<CR>`

Purpose: Use `wrext` to command the GPIB-SCSI-A to process the Group 1 SCSI WRITE command.

Remarks: The GPIB-SCSI-A uses the following Command Descriptor Block to command the Target to process `wrext`. Notice how the parameters to the `wrext` command are used in the creation of the Command Descriptor Block.

Bit / Byte	7	6	5	4	3	2	1	0
0	2A							
1	LUN			00				
2	Logical Block Address (Most Significant Byte							
3	Logical Block Address (Up.-Middle Significant Byte)							
4	Logical Block Address (Low-Middle Significant Byte)							
5	Logical Block Address (Least Significant Byte)							
6	00							
7	Transfer Length (Most Significant Byte)							
8	Transfer Length (Least Significant Byte)							
9	VCB			00				

The Logical Block Address and Transfer Length in the Command Descriptor Block above are given as parameters to the `wrext` command. The LUN corresponds to the last value assigned with the `lun` command. The VCB corresponds to the last value assigned with the `vcb` command.

wrext (continued)

The Logical Block Address notifies the Target as to where the data is written on the device. The Transfer Length is the number of blocks that the Target must obtain from the GPIB-SCSI-A and write during the Data Out phase.

During the execution of this command, if the GPIB-SCSI-A encounters a phase which it does not expect, an EPHS error indication results. For a list of the expected phases, refer to the section titled *Handling of SCSI Phases in G Mode* in Chapter 6, *Programming in G Mode.*

Refer to your SCSI device documentation for expected values in each byte of the Command Descriptor Block and the SCSI phases that the device creates during the execution of this command.

If you enter **wre**`xt?`, the GPIB-SCSI-A places the last used values for `logical block address` and `transfer length` into the Command and Status Channel buffer followed by a <CR><LF>.

`logical block address` represents a 32-bit unsigned number. Correct values range from 0 to 4,294,967,296. `transfer length` represents a 16-bit unsigned number.

Correct values range from 0 to 65,535. If numbers that are too large are entered, there is a syntax error in a number, or there are no numbers, the GPIB-SCSI-A aborts the command with an EARG error indication.

See Also: *blksze*, *dtin*, *dtout*, *pad*, *rdext*, *read*, *write*, and Appendix D, *Operation of the SCSI.*

wrext (continued)

Example:

This example causes the GPIB-SCSI-A to write one block of data at Logical Block Address 5000 to the Target with a SCSI ID of 4 and a blocksize of 512 bytes. After the GPIB-SCSI-A detects END on a byte transfer from the GPIB Talker, the GPIB-SCSI-A sends the carriage return byte set up by the **p**ad command to pad the rest of the transfer to prevent the GPIB-SCSI-A and SCSI from hanging.

```
ibwrt (gpibscsia, "stat c n\n", 9);

/* Request the GPIB-SCSI-A to report numerical
 * status continuously.
 */

ibwrt (gpibscsia, "tid 4\n", 6);

/* Request to the GPIB-SCSI-A to communicate
 * with SCSI Target with ID of 4.
 */

ibwrt (gpibscsia, "pad 13\n", 7);

/* Tell the GPIB-SCSI-A that you want the pad
 * byte to be a carriage return symbol.
 */

ibwrt (gpibscsia, "blksz 512\n", 10);

/* Tell the GPIB-SCSI-A that the drive has
 * a blocksize of 512 bytes.  This information
 * can be found either in the documentation of
 * the SCSI disk drive or by executing the SCSI
 * MODE SENSE command either through a
 * low-level command sequence or with the
 * high-level mdsns command provided by the
 * GPIB-SCSI-A.
 */
```

wrext (continued)

```
ibwrt (gpibscsia, "wrext 5000, 1\n", 14);

/* Request the GPIB-SCSI-A to write data
 * to the SCSI Target at ID 4.  This command
 * also tells the GPIB-SCSI-A that there
 * is a maximum of 512 bytes (blksz *
 * transfer length, 1 * 512) transferred from
 * the GPIB Talker to the SCSI.  If the
 * GPIB-SCSI-A detects END from the GPIB, the
 * SCSI device still receives 512 bytes, but
 * the last bytes will be pad bytes.
 */

ibwrt (scsidev, "Put this data on the disk",
25);

/* Write the string to the disk drive across
 * the Data Channel. The NI GPIB call asserts
 * the GPIB EOI* signal on the last byte of
 * the string, notifies the GPIB-SCSI-A that
 * all the GPIB data is transferred.  Now the
 * GPIB-SCSI-A sends out 487 (512 - 25)
 * carriage return characters.
 */
```

write - Write

Type: SCSI function

Syntax: `write logical block address, transfer length<CR>`
or
`write?<CR>`

Purpose: Use `write` to command the GPIB-SCSI-A to process the Group 0 SCSI WRITE command.

Remarks: The GPIB-SCSI-A uses the following Command Descriptor Block to command the Target to process `write`. Notice how the parameters to the `write` command are used in the creation of the Command Descriptor Block.

Bit / Byte	7	6	5	4	3	2	1	0
0	0A							
1	LUN			Logical Block (Upper 5 bits)				
2	Logical Block Address (Middle Significant Byte)							
3	Logical Block Address (Least Significant Byte)							
4	Transfer Length							
5	VCB		00					

The Logical Block Address and Transfer Length in the Command Descriptor block above are given as parameters to the `write` command. The LUN corresponds to the last value assigned with the `lun` command. The VCB corresponds to the last value assigned with the `vcb` command.

The Logical Block Address notifies the Target as to where the data should be written on the device. The Transfer Length is the number of blocks that the Target must transfer during the Data Out phase. A zero represents 256 blocks.

write (continued)

During the execution of this command, if the GPIB-SCSI-A encounters a phase which it does not expect, an EPHS error indication results. For a list of the expected phases, refer to the section titled *Handling of SCSI Phases in G Mode* in Chapter 6, *Programming in G Mode.*

Refer to your SCSI device documentation for expected values in each byte of the Command Descriptor Block and the SCSI phases that the device creates during the execution of this command.

If you enter `write?`, the GPIB-SCSI-A places the last used values for `logical block address` and `transfer length` into the Command and Status Channel buffer followed by a <CR><LF>.

`logical block address` represents a 21-bit unsigned number. Correct values range from 0 to 2,097,152. `transfer length` represents an 8-bit unsigned number. Correct values range from 0 to 255. If numbers that are too large are entered, there is a syntax error in a number, or there are no numbers, the GPIB-SCSI-A aborts the command with an EARG error indication.

See Also: *dtin*, *dtout*, *rdext*, *read*, *wrext*, *blksz*, *pad*, and Appendix D, *Operation of the SCSI.*

Example:

This example causes the GPIB-SCSI-A to write ten blocks of data (stored in `databuf`) beginning at Logical Block Address 100 from the Target with a SCSI ID of 4 and a blocksize of 512 bytes. The byte that the GPIB-SCSI-A uses as a filler byte will be the line feed character.

write (continued)

```
ibwrt (gpibscsia, "stat c n\n", 9);

/* Request the GPIB-SCSI-A to report
 * numerical status continuously.
 */

ibwrt (gpibscsia, "tid 4\n", 6);

/* Request the GPIB-SCSI-A to communicate with
 * the SCSI Target with an ID of 4.
 */

ibwrt (gpibscsia, "pad 10\n", 7);

/* Indicate that you want the pad byte to be a
 * linefeed character.
 */

ibwrt (gpibscsia, "blksz 512\n", 10);

/* Tell the GPIB-SCSI-A that the drive has
 * a blocksize of 512 bytes.  This information
 * can be found either in the documentation of
 * the SCSI disk drive or by executing the SCSI
 * MODE SENSE command either through a low-
 * level command sequence or with the high-
 * level mdsns command provided by the
 * GPIB-SCSI-A.
 */

ibwrt (gpibscsia, "write 100, 10\n", 14);

/* Tell the GPIB-SCSI-A that you want to write
 * data to the SCSI Target at ID 4.  This
 * command also tells the GPIB-SCSI-A that
 * there will be a total of 5,120 bytes (blksz
 * transfer length, 10 * 512) desired by the
 * SCSI Target. The GPIB may not have this
```

write (continued)

```
    * exact count available.  However, the
    * GPIB-SCSI-A will pad the data so that the  *
SCSI device gets a known number of bytes to
    * prevent locking up the GPIB-SCSI-A and the
    * SCSI.
    */

            ibwrt (scsidev, databuf, 4981);

   /* Write 4,981 bytes of data from a memory
    * buffer to the GPIB-SCSI-A which in turn puts
    * the data onto the SCSI Target.  When the NI
    * function call sends the last byte of data,
    * the EOI* GPIB signal is driven active to
    * indicate the last byte.  The GPIB-SCSI-A
    * detects this and stops attempting to get
    * GPIB data, but sends out 139 (5120-4981)
    * linefeed characters as filler to the SCSI
    * Target.
    */
```

wrtbuf - Write Buffer

Type: SCSI function

Syntax: **wrtb**uf buffer id, buffer offset, allocation length<CR>

Purpose: Use **wrtb**uf to command the GPIB-SCSI-A to process the Group 1 SCSI WRITE BUFFER command.

Remarks: The GPIB-SCSI-A uses the following Command Descriptor Block to command the Target to process **wrtb**uf. Notice how the parameters to the **wrtb**uf command are used in the creation of the Command Descriptor Block.

Bit / Byte	7	6	5	4	3	2	1	0
0	3B							
1	LUN			02				
2	Buffer Id							
3	Buffer Offset (Most Significant Byte)							
4	Buffer Offset (Middle Significant Byte)							
5	Buffer Offset (Least Significant Byte)							
6	Allocation Length (Most Significant Byte)							
7	Allocation Length (Middle Significant Byte)							
8	Allocation Length (Least Significant Byte)							
9	VCB		00					

The Buffer Id, Buffer Offset, and Allocation Length in the Command Descriptor Block above are given as a parameters to the **wrtb**uf command. The LUN corresponds to the last value assigned with the **l**un command. The VCB corresponds to the last value assigned with the **v**cb command.

wrtbuf (continued)

The Buffer Id notifies the Target as to which internal buffer it should use. The Buffer Offset notifies the Target where in the buffer data is transferred. The Allocation Length is the number of bytes to send during the Data Out phase. An Allocation Length of 0 indicates that no data is transferred. This condition is not considered an error. Any other value indicates the maximum number of bytes that can be transferred. The Target terminates the Data Out phase when Allocation Length bytes have been transferred.

During the execution of this command, if the GPIB-SCSI-A encounters a phase which it does not expect, an EPHS error indication results. For a list of the expected phases, refer to the section titled *Handling of SCSI Phases in G Mode* in Chapter 6, *Programming in G Mode.*

Refer to your SCSI device documentation for expected values in each byte of the Command Descriptor Block, the SCSI phases that the device creates during the execution of this command, and the format and meaning of the **wrtb**uf data. `buffer id` represents an 8-bit unsigned number. Correct values range from 0 to 255. `buffer offset` and `allocation length` represent 24-bit unsigned numbers. Correct values range from 0 to 16,777,216. If numbers that are too large are entered, there is a syntax error in a number, or there are no numbers, the GPIB-SCSI-A aborts the command with an EARG error indication.

See Also: *rdbuf.*

wrtbuf (continued)

Example:

```
ibwrt (gpibscsia, "wrtbuf 1, 0, 10\n", 16);

/* Tell the GPIB-SCSI-A to complete a SCSI
 * WRITE Buffer command.  The rest of the
 * command is requesting that the Target write
 * 10 bytes of data to the beginning of its
 * first buffer.
 */
ibwrt (scsidev, "5555555555", 10);

/* Send the data to store in the memory buffer
 * across the Data Channel.
 */
```

Appendix A
Multiline Interface Messages

This appendix contains an interface message reference list, which describes the mnemonics and messages that correspond to the interface functions. These multiline interface messages are sent and received with ATN TRUE.

For more information on these messages, refer to the ANSI/IEEE Std. 488.1-1987, *IEEE Standard Digital Interface for Programmable Instrumentation*.

Multiline Interface Messages

Hex	Oct	Dec	ASCII	Msg	Hex	Oct	Dec	ASCII	Msg
00	000	0	NUL		20	040	32	SP	MLA0
01	001	1	SOH	GTL	21	041	33	!	MLA1
02	002	2	STX		22	042	34	"	MLA2
03	003	3	ETX		23	043	35	#	MLA3
04	004	4	EOT	SDC	24	044	36	$	MLA4
05	005	5	ENQ	PPC	25	045	37	%	MLA5
06	006	6	ACK		26	046	38	&	MLA6
07	007	7	BEL		27	047	39	'	MLA7
08	010	8	BS	GET	28	050	40	(	MLA8
09	011	9	HT	TCT	29	051	41	)	MLA9
0A	012	10	LF		2A	052	42	*	MLA10
0B	013	11	VT		2B	053	43	+	MLA11
0C	014	12	FF		2C	054	44	,	MLA12
0D	015	13	CR		2D	055	45	-	MLA13
0E	016	14	SO		2E	056	46	.	MLA14
0F	017	15	SI		2F	057	47	/	MLA15
10	020	16	DLE		30	060	48	0	MLA16
11	021	17	DC1	LLO	31	061	49	1	MLA17
12	022	18	DC2		32	062	50	2	MLA18
13	023	19	DC3		33	063	51	3	MLA19
14	024	20	DC4	DCL	34	064	52	4	MLA20
15	025	21	NAK	PPU	35	065	53	5	MLA21
16	026	22	SYN		36	066	54	6	MLA22
17	027	23	ETB		37	067	55	7	MLA23
18	030	24	CAN	SPE	38	070	56	8	MLA24
19	031	25	EM	SPD	39	071	57	9	MLA25
1A	032	26	SUB		3A	072	58	:	MLA26
1B	033	27	ESC		3B	073	59	;	MLA27
1C	034	28	FS		3C	074	60	<	MLA28
1D	035	29	GS		3D	075	61	=	MLA29
1E	036	30	RS		3E	076	62	>	MLA30
1F	037	31	US		3F	077	63	?	UNL

Message Definitions

DCL	Device Clear
GET	Group Execute Trigger
GTL	Go To Local
LLO	Local Lockout
MLA	My Listen Address
MSA	My Secondary Address
MTA	My Talk Address
PPC	Parallel Poll Configure
PPD	Parallel Poll Disable

Multiline Interface Messages

Hex	Oct	Dec	ASCII	Msg	Hex	Oct	Dec	ASCII	Msg
40	100	64	@	MTA0	60	140	96	`	MSA0,PPE
41	101	65	A	MTA1	61	141	97	a	MSA1,PPE
42	102	66	B	MTA2	62	142	98	b	MSA2,PPE
43	103	67	C	MTA3	63	143	99	c	MSA3,PPE
44	104	68	D	MTA4	64	144	100	d	MSA4,PPE
45	105	69	E	MTA5	65	145	101	e	MSA5,PPE
46	106	70	F	MTA6	66	146	102	f	MSA6,PPE
47	107	71	G	MTA7	67	147	103	g	MSA7,PPE
48	110	72	H	MTA8	68	150	104	h	MSA8,PPE
49	111	73	I	MTA9	69	151	105	i	MSA9,PPE
4A	112	74	J	MTA10	6A	152	106	j	MSA10,PPE
4B	113	75	K	MTA11	6B	153	107	k	MSA11,PPE
4C	114	76	L	MTA12	6C	154	108	l	MSA12,PPE
4D	115	77	M	MTA13	6D	155	109	m	MSA13,PPE
4E	116	78	N	MTA14	6E	156	110	n	MSA14,PPE
4F	117	79	O	MTA15	6F	157	111	o	MSA15,PPE
50	120	80	P	MTA16	70	160	112	p	MSA16,PPD
51	121	81	Q	MTA17	71	161	113	q	MSA17,PPD
52	122	82	R	MTA18	72	162	114	r	MSA18,PPD
53	123	83	S	MTA19	73	163	115	s	MSA19,PPD
54	124	84	T	MTA20	74	164	116	t	MSA20,PPD
55	125	85	U	MTA21	75	165	117	u	MSA21,PPD
56	126	86	V	MTA22	76	166	118	v	MSA22,PPD
57	127	87	W	MTA23	77	167	119	w	MSA23,PPD
58	130	88	X	MTA24	78	170	120	x	MSA24,PPD
59	131	89	Y	MTA25	79	171	121	y	MSA25,PPD
5A	132	90	Z	MTA26	7A	172	122	z	MSA26,PPD
5B	133	91	[	MTA27	7B	173	123	{	MSA27,PPD
5C	134	92	\	MTA28	7C	174	124	|	MSA28,PPD
5D	135	93	]	MTA29	7D	175	125	}	MSA29,PPD
5E	136	94	^	MTA30	7E	176	126	~	MSA30,PPD
5F	137	95	_	UNT	7F	177	127	DEL	

PPE	Parallel Poll Enable	SPE	Serial Poll Enable
PPU	Parallel Poll Unconfigure	TCT	Take Control
SDC	Selected Device Clear	UNL	Unlisten
SPD	Serial Poll Disable	UNT	Untalk

Appendix B
Status and Message Information

This appendix describes the status and error information that the GPIB-SCSI-A records as it executes each programming message. Also described are the SCSI message bytes that the GPIB-SCSI-A responds to or generates while operating, as well as the Extended Sense keys that the GPIB-SCSI-A uses. The number preceding each description is the numeric value in decimal of that bit or code.

Status Bits

S Mode

The following paragraphs describe the conditions represented by the bits in status for S Mode.

ERR -32768

The ERR bit is set following any call that results in an error. The particular error can be determined by examining the GPIB error and SCSI error values. The ERR bit is cleared following any call that does not result in an error.

Note: By examining this bit, you can check for an error condition after each call. An error made early in your application program may not become apparent until a later instruction. At that time, the error can be more difficult to locate.

TIMO 16384

The TIMO bit indicates a timeout. The TIMO bit is set in the status word following a call to `wait`, if the TIMO bit of the wait mask parameter is also set and if the wait has exceeded the time limit value that is set by the `tmo` call. The TIMO bit is also set following a call to any of the I/O functions (for example, `rd`, `wrt`, `brd`, `bwrt`, and `cmd`), if a timeout occurs during a call. The TIMO bit is cleared in the status word in all other circumstances.

END 8192

The END bit indicates if the END or EOS message has been received. The END bit is set in the status word following a `rd` or `brd` function if the END or EOS message was detected during the read. While the GPIB-SCSI-A is performing a shadow handshake as a result of the `gts` function, any other function call may return a status word with the END bit set if the END or EOS message occurred before or during that call. The END bit is cleared in the status word at the start of any subsequent programming message.

SRQI 4096

The SRQI bit indicates if a device is requesting service. This bit is set in the status word whenever the SRQ* line is asserted. The bit is cleared whenever the GPIB SRQ* line is unasserted.

CMPL 256

The CMPL bit indicates that the operation relating to this status information is complete. This bit is always set, and is useful in identifying the status word from other responses.

LOK 128

The LOK bit indicates if the GPIB-SCSI-A is in a lockout state. The LOK bit is set whenever the GPIB-SCSI-A detects that the Local Lockout (LLO) message has been sent either by the GPIB-SCSI-A or by another Controller. The LOK bit is cleared when the Remote Enable (REN*) GPIB line becomes unasserted either by the GPIB-SCSI-A or by another Controller.

REM 64

The REM bit indicates if the GPIB-SCSI-A is in remote state. The REM bit is set whenever the Remote Enable (REN*) GPIB line is asserted and the GPIB-SCSI-A detects that its listen address has been sent either by the GPIB-SCSI-A or by another Controller. The REM bit is cleared whenever REN* becomes unasserted, or when the GPIB-SCSI-A as a Listener detects the Go to Local (GTL) command sent either by the GPIB-SCSI-A or by another Controller, or when the `loc` function is called while the LOK bit is cleared in status.

CIC 32

The CIC bit indicates if the GPIB-SCSI-A is the Controller-In-Charge. The CIC bit is set whenever `sic` is called while the GPIB-SCSI-A is System Controller, or when another Controller passes control to the GPIB-SCSI-A. The CIC bit is cleared whenever the GPIB-SCSI-A detects Interface Clear (IFC*) from some other device that is System Controller, or when the GPIB-SCSI-A passes control to another device.

ATN 16

The ATN bit indicates the state of the GPIB Attention (ATN*) line. The ATN bit is set whenever the GPIB ATN* line is asserted and cleared when the ATN* line is unasserted.

TACS 8

The TACS bit indicates if the GPIB-SCSI-A has been addressed as a Talker. The TACS bit is set whenever the GPIB-SCSI-A detects that its talk address (and secondary address, if enabled) has been sent either by the GPIB-SCSI-A itself or by another Controller. The TACS bit is cleared whenever the GPIB-SCSI-A detects the Untalk (UNT) command, a talk address other than its own, its own listen address, or IFC*.

LACS 4

The LACS bit indicates if the GPIB-SCSI-A has been addressed as a Listener. The LACS bit is set whenever the GPIB-SCSI-A detects that its listen address (and secondary address, if enabled) has been sent either by the GPIB-SCSI-A itself or by another Controller. The LACS bit is also set whenever the GPIB-SCSI-A shadow handshakes as a result of the `gts` function. The LACS bit is cleared whenever the GPIB-SCSI-A detects that the Unlisten (UNL) command, its own talk address, IFC*, or `gts` is called without shadow handshake.

DTAS 2

The DTAS bit indicates if the GPIB-SCSI-A has detected a device trigger command. The DTAS bit is set whenever the GPIB-SCSI-A, as a Listener, detects that the Group Execute Trigger (GET) command has been sent by another Controller. The DTAS bit is cleared in status at the start of any subsequent programming message.

DCAS 1

The DCAS bit indicates if the GPIB-SCSI-A has detected a Device Clear (DCL) command. The DCAS bit is set whenever the GPIB-SCSI-A detects the DCL command sent by another Controller. The DCAS bit is also set when the GPIB-SCSI-A, as a Listener, detects the Selected Device Clear (SDC) command has been sent by another Controller. The DCAS bit is cleared in status at the start of any subsequent programming message.

In addition to the previously described conditions, the following situations also affect the bits in status:

- A call to the `onl` function clears the following bits:

-	END	-	TACS
-	LOK	-	LACS
-	REM	-	DTAS
-	CIC	-	DCAS

- A call to `onl` affects bits other than those listed here according to the rules explained for each bit.

G Mode

The following paragraphs describe the conditions represented by the bits in status for G Mode.

ERR -32768

The ERR bit is set following any call that results in an error. The particular error can be determined by examining the GPIB error and SCSI error values. The ERR bit is cleared following any call that does not result in an error.

Note: By examining this bit, you can check for an error condition after each call. An error made early in your application program may not become apparent until a later instruction. At that time, the error can be more difficult to locate.

CMPL 256

The CMPL bit indicates if the operation relating to this status information is complete. This bit is always set, and is useful in identifying the status word from other responses.

MGIN 128

The MGIN bit indicates that the SCSI bus that the GPIB-SCSI-A is attached to is currently in the Message In phase. This indication is useful if you are performing low-level SCSI calls and you need to know that the selected Target is expecting to send the Initiator, usually the GPIB-SCSI-A, a message byte.

MOUT 64

The MOUT bit indicates that the SCSI bus to which the GPIB-SCSI-A is attached is currently in the Message Out phase. This indication is useful if you are performing low-level SCSI calls and you need to know that the selected Target is expecting a message byte from the Initiator, usually the GPIB-SCSI-A.

BSFR 32

The BSFR bit indicates that the SCSI bus to which the GPIB-SCSI-A is attached is currently in the Bus Free phase. This means that the SCSI BSY* signal is not asserted and that a SCSI sequence can be initiated.

SLCT 16

The SLCT bit indicates that the SCSI bus to which the GPIB-SCSI-A is attached is currently in the Selection phase. This bit is only set during low-level SCSI commands after successful arbitration for the SCSI but before attempting to select a Target.

STAT 8

The STAT bit indicates that the SCSI bus to which the GPIB-SCSI-A is attached is currently in the Status phase. This indication is useful if you are performing low-level SCSI calls and you need to know that the selected Target is expecting to send the Initiator, usually the GPIB-SCSI-A, a status byte.

If this bit is set after performing a high-level SCSI call, there was some problem with the operation. You can obtain both the status and message bytes from the Target by using `cmp`.

COMD 4

The COMD bit indicates that the SCSI bus to which the GPIB-SCSI-A is attached is currently in the Command phase. This indication is useful if you are performing low level SCSI calls and you need to know that the selected Target is expecting to receive from the Initiator, usually the GPIB-SCSI-A, a Command Descriptor Block.

DTIN 2

The DTIN bit indicates that the SCSI bus to which the GPIB-SCSI-A is attached is currently in the Data In phase. This indication is useful if you are performing low-level SCSI calls and you need to know that the selected Target is expecting to send to the Initiator, usually the GPIB-SCSI-A, data bytes.

DOUT 1

The DOUT bit indicates that the SCSI bus to which the GPIB-SCSI-A is attached is currently in the Data Out phase. This indication is useful if you are performing low-level SCSI calls and you need to know that the selected Target is expecting to receive from the Initiator, usually the GPIB-SCSI-A, data bytes.

The status bits are updated each time you perform the `stat` command. If you have enabled continuous status reporting, they are updated automatically at the end of each command.

GPIB Error Codes

When the ERR bit is set in status, a GPIB or a SCSI error has occurred. The error code is indicated by GPIB error or SCSI error. Because there are similar errors in both modes, the GPIB errors are discussed in the section below. If the error is valid for S mode only, S is indicated. If the error is

valid for G mode only, G is indicated. If the error is valid for S mode and G mode, S/G is indicated. Only one GPIB error can exist at any time.

The following paragraphs describe the GPIB errors in detail.

NGER S/G 0

The GPIB-SCSI-A reports this value when no GPIB errors were detected as a result of the last operation.

ECIC S 1

The GPIB-SCSI-A records this error when you call a function that requires that the GPIB-SCSI-A be Controller-In-Charge (CIC) and it is not CIC.

In cases when the GPIB-SCSI-A should always be the CIC, call `sic` to send Interface Clear. In multiple CIC situations, you can call `wait` (CIC) to delay further processing until control is passed to the GPIB-SCSI-A.

ENOL S/G 2

The ENOL error occurs most frequently when the GPIB-SCSI-A attempts to write to the GPIB and there are no Listeners addressed.

In S mode, the remedy is to be sure that the proper listen address is in the Command Descriptor Block, to use `cmd` to properly address the Listeners, or to be sure some other Controller has addressed the Listeners before writing data.

This error occurs less frequently in situations where the GPIB-SCSI-A is not the CIC and the Controller asserts ATN before the G mode **`rd`**`ext`, or **`dti`**`n` call in progress or the S mode `wrt` or `bwrt` call in progress terminates. Either reduce the write byte count to that which is expected by the Controller or resolve the situation on the Controller's end.

EADR S 3

The GPIB-SCSI-A records this error when it is not addressed to listen or talk before a call to `brd` or `bwrt` when it is CIC. Be sure that the GPIB-SCSI-A is properly addressed before attempting the `brd` or `bwrt`.

The GPIB-SCSI-A also records this error during the function `gts` when the shadow-handshake feature is requested and the GPIB ATN* line is already unasserted. In this case, the shadow handshake is not possible and the error is recorded to notify you of that fact. `gts` should almost never be called except immediately after a `cmd` call. (`cmd` causes ATN* to be asserted.)

EARG G 4

The GPIB-SCSI-A records this error when you pass an invalid argument to a function call. The following are some examples:

- `read` called with only one parameter
- `write` called with the second parameter larger than 256
- `tid` called with no parameter and no '?'

If your programming message contains more than one argument and you get this error, the GPIB-SCSI-A discards all arguments and does not perform the function.

This error can also be caused by a transmission error which corrupts the argument portion of the programming message or which corrupts the <CR> or <LF> that terminates the programming message.

ESAC S 5

The GPIB-SCSI-A records this error if `sic` or `sre` is called when the GPIB-SCSI-A does not have System Controller capability. The remedy is to give the GPIB-SCSI-A that capability by calling `rsc`. (At power on, the GPIB-SCSI-A assumes itself to be the System Controller.)

EABO S 6

The GPIB-SCSI-A records this error when I/O has been cancelled. The most common cause of this error is a timeout condition.

To remedy a timeout error (if I/O is actually progressing but times out anyway), lengthen the timeout period with `tmo`. More frequently, however, the I/O is stuck (the Listener is not continuing to handshake or the Talker has stopped talking) or the byte count in the call that timed out is not what the other device was expecting. Be sure that both parties to the transfer understand what byte count is expected or, if possible, have the Talker use the END message to assist in early termination.

ECAP S 11

This error results when a particular capability has been disabled in the GPIB-SCSI-A and a call is made that attempts to make use of that capability.

EBUS S 14

This error indicates that there was a problem sending command bytes out of the GPIB port. The most common causes of this error are either that the bytes could not be sent out within the timeout period, or that there was not a device on the GPIB bus to receive the command bytes. This error can occur during `clr`, `loc`, `pct`, `ppc`, `ppu`, `rd`, `rsp`, `trg`, or `wrt`.

ECMD G 17

The GPIB-SCSI-A records this error if the programming message received by the GPIB-SCSI-A does not contain a recognizable function name. This can happen if the function name is misspelled or if a function is requested that does not exist. Check the spelling and validity of your function name.

SCSI Error Codes

If the ERR bit is set in status and NGER is reported for GPIB error, you should check SCSI error to determine the problem that occurred on the SCSI. Because there are similar errors in both modes, the SCSI errors are discussed in the section below. If the error is valid for S mode only, S is indicated. If the error is valid for G mode only, G is indicated. If the error is valid for S mode and G mode, S/G is indicated. Only one SCSI error can exist at any time.

The following paragraphs describe the SCSI errors in detail.

NSER S/G 0

The GPIB-SCSI-A reports this value if no SCSI errors were detected as a result of the last operation.

EARB G 1

The GPIB-SCSI-A records this value if the GPIB-SCSI-A attempts to arbitrate for the SCSI bus, but fails to gain the bus because there is already another Initiator-Target using the SCSI. The GPIB-SCSI-A also records this value if another Initiator with a higher priority than the GPIB-SCSI-A was arbitrating at the same time.

ESEL G 2

The GPIB-SCSI-A records this error if the GPIB-SCSI-A attempts to select the specified Target and the Target does not respond.

EPHS G 4

The GPIB-SCSI-A records this error if the GPIB-SCSI-A is performing a high-level SCSI operation and the selected Target enters an unexpected phase that the GPIB-SCSI-A is not prepared to handle. If this occurs, you must use the low-level function calls to perform the desired command.

ECER G 5

The GPIB-SCSI-A records this error if the Target that is communicating with the GPIB-SCSI-A unexpectedly releases the SCSI BSY* signal without either notifying the GPIB-SCSI-A of its intention to disconnect or finishing the command normally by going through the Status and Message In phases.

EPAR S/G 6

The GPIB-SCSI-A records this error if it is configured to detect and report SCSI parity errors and the GPIB-SCSI-A detects a parity error on any read of data from the SCSI bus. This is configurable with Switch 7 of configuration switch SW2.

TST0 - TST7 G 128-135 (80-87 hex)

The GPIB-SCSI-A records this error if it is configured for automatic testing (by the **a**`utotst` command), and the GPIB-SCSI-A detects an error on a Test Unit Ready command issued to one of the specified SCSI Target IDs. The lowest three bits of this error code indicate which SCSI Target ID had the error. In order to determine the exact error that occurred, you can issue the **t**`stur` command to the SCSI Target ID indicated by the lowest three bits.

Status Bytes

The following paragraphs describe the bytes that may be sent in the Status phase while operating in S mode. In G mode the GPIB-SCSI-A does not generate status bytes. The status bytes are generated by the individual SCSI devices attached to your system. These bytes have the meaning that your device places on them. For specific information about the status bytes in G mode, see the instructions in your device documentation.

The status byte, as defined by the SCSI specification, is set up as follows:

- Bit 7, the highest bit, is Reserved and should be 0.
- Bits 6, 5, and 0 are vendor unique and may or may not have meaning for your particular device.
- Bits 4 through 1 indicate the status, as listed later in this appendix.

For this section only, the status is displayed as a binary number with R signifying reserved and V signifying vendor unique. R should always be zero and the V bits are assigned a meaning by the specific SCSI Target.

In S mode, the GPIB-SCSI-A clears bits 7, 6, and 5. Bit 0 is set to 1 after a `RD` or `BRD` command and subsequent `STAT` commands if END occurred during the read. Otherwise, bit 0 is cleared.

GOOD	RVV 0000 V This status indicates that the command completed without any errors.
CHECK CONDITION	RVV 0001 V This status indicates that some error occurred in the execution of the command. To discover the cause of the error, issue a request sense command (**`rq`**`sns` in G mode, 3 in S mode) to the Target which reported the error.

For more information on the sense data returned by the GPIB-SCSI-A in S mode, see the *Sense Keys* section later in this appendix. For information on sense data returned by your device while operating in G mode, see your device documentation.

Message Bytes

This section describes the messages that the GPIB-SCSI-A automatically generates or responds to during operation. For specific information about the message bytes in G mode, see the instructions in your device documentation.

COMMAND COMPLETE 0

The GPIB-SCSI-A sends this message to the Initiator while operating in S mode to indicate that the requested command is completed.

While operating in G mode, the Target that has been selected by the GPIB-SCSI-A must finish out the command sequence with this message. The GPIB-SCSI-A does not respond in any way to this message; it simply stores the message in the buffer of the Command and Status Channel.

EXTENDED MESSAGE 1

In S mode, this message is sent by the GPIB-SCSI-A as the first byte of a multiple-byte message. The only multiple byte message sent by the GPIB-SCSI-A is that sent during continuous status reporting. See the S mode `stat` command for details.

In G mode, the GPIB-SCSI-A receives all the message bytes from the Target and places them in the Command and Status Channel buffer.

SAVE DATA POINTER 2

The GPIB-SCSI-A sends this message to the Initiator while operating in S mode prior to issuing the DISCONNECT message to direct the Initiator to save a copy of the present active data pointer for this data transfer.

In G mode, the GPIB-SCSI-A receives the message from the Target and places it in the Command and Status Channel buffer.

DISCONNECT 4

The GPIB-SCSI-A sends this message to the Initiator while operating in S mode to indicate its intention to disconnect from the SCSI.

In G mode, the DISCONNECT message tells the GPIB-SCSI-A that the Target is disconnecting from the SCSI bus. DISCONNECT also tells the GPIB-SCSI-A that the disappearance of the SCSI BSY* signal is not an error. After this message is received, the GPIB-SCSI-A waits to be reconnected before further processing. All of this is handled transparently to the user; however, all the Message In bytes required for this command are placed in the Command and Status Channel buffer.

Typically, there are two extra bytes preceding the Status and Message In bytes normally found in the Command and Status Channel buffer after a command in which disconnection was performed. These two extra bytes are 0x04 for the DISCONNECT message and 0x80 for the IDENTIFY message, which the Target sends after reconnection.

ABORT 6

While operating in S mode, the GPIB-SCSI-A aborts a command in progress upon reception of this message. If no command is pending when this message is received, it has no effect. Since the GPIB-SCSI-A only receives messages after being selected, this message can only be used to abort a command that has disconnected temporarily.

While operating in G mode, the GPIB-SCSI-A sends this message to the Target in order to abort the command in progress.

MESSAGE REJECT7

While operating in S mode, the GPIB-SCSI-A sends this message to the Initiator in order to indicate that the last message it received was inappropriate or has not been implemented.

In G mode, the GPIB-SCSI-A receives the message from the Target and places it in the Command and Status Channel buffer.

BUS RESET DEVICE 12

While operating in S mode, the GPIB-SCSI-A treats this message the same as the ABORT message.

While operating in G mode, the GPIB-SCSI-A sends this message to the Target to clear all current commands on that Target.

IDENTIFY 128 to 255

While operating in S mode, the GPIB-SCSI-A sends this message to the Initiator immediately after reconnection to re-establish the data path to the Initiator. The GPIB-SCSI-A also recognizes this message when the Initiator uses it to indicate that it can support disconnection and reconnection.

While operating in G mode, the GPIB-SCSI-A sends this message to the Target to determine whether or not the GPIB-SCSI-A can support disconnection with specific commands. The GPIB-SCSI-A also receives this message from the Target after reselection has completed, but the GPIB-SCSI-A does no special processing of the message. It is just placed into the buffer of the Command and Status Channel.

While operating in S mode, the GPIB-SCSI-A does not deliver any message other than the ones described above. If the GPIB-SCSI-A receives a message that is inappropriate or has not been implemented, it returns the MESSAGE REJECT message.

If the Target that you wish to communicate with in G mode uses different messages, or needs to be given different messages, you must use the low-level commands provided.

Sense Keys

The following paragraphs describe the possible Sense keys that the GPIB-SCSI-A can issue while operating in S mode. The Sense key is returned in byte 2 of the sense data.

In G mode, the GPIB-SCSI-A does not generate Sense data. Instead, the Sense data is generated by the individual SCSI device. For specific information about the Sense keys issued by the SCSI devices, see the instructions in your device documentation.

NO SENSE 0

This sense key indicates that there is no specific sense key available. One way to receive this sense key is if the previous command completes correctly.

ILLEGAL REQUEST 5

This sense key indicates that there was an illegal opcode or parameter in the Command Descriptor Block.

ERROR 9

This sense key indicates that the GPIB-SCSI-A encountered some error on the last command. The source of the error is determined by examining the GPIB error indicator `(iberr)` and the SCSI error indicator `(scerr)`.

ABORTED COMMAND 11

This sense key indicates that the GPIB-SCSI-A aborted the command. The Initiator may be able to recover by trying the command again.

Appendix C
Operation of the GPIB

This appendix describes the operation of the GPIB.

Communication among interconnected GPIB devices is achieved by passing messages through the interface system.

Types of Messages

The GPIB carries device-dependent messages and interface messages.

- Device-dependent messages, often called *data* or *data messages*, contain device-specific information such as programming instructions, measurement results, machine status, and data files.
- Interface messages manage the bus itself. They are usually called *commands* or *command messages*. Interface messages perform such tasks as initializing the bus, addressing and unaddressing devices, and setting device modes for remote or local programming.

The term *command* as used here should not be confused with some device instructions which can also be called commands. Such device-specific instructions are actually data messages.

Talkers, Listeners, and Controllers

A Talker sends data messages to one or more Listeners. The Controller manages the flow of information on the GPIB by sending commands to all devices.

Devices can be Listeners, Talkers, and/or Controllers. A digital voltmeter, for example, is a Talker when sending measurements and is a Listener when receiving programming messages.

The GPIB is a bus like an ordinary computer bus, except that the computer has its circuit cards interconnected via a backplane bus, whereas the GPIB has stand-alone devices interconnected via a cable bus.

The role of the GPIB Controller can also be compared to the role of the CPU of a computer, but a better analogy is to the switching center of a city telephone system.

The switching center (Controller) monitors the communications network (GPIB). When the center (Controller) notices that a party (device) wants to make a call (send a data message), it connects the caller (Talker) to the receiver (Listener).

The Controller addresses a Talker and a Listener before the Talker can send its message to the Listener. After the message is transmitted, the Controller may unaddress both devices.

Some bus configurations do not require a Controller. For example, one device may always be a Talker (called a talk-only device) and there may be one or more listen-only devices.

A Controller is necessary when the active or addressed Talker or Listener must be changed. The Controller function is usually handled by a computer.

If the GPIB-SCSI-A is in S mode, your SCSI host plays all three roles.

- Controller–to manage the GPIB
- Talker–to send data to an attached GPIB device
- Listener–to receive data from an attached GPIB device

If the GPIB-SCSI-A is in G mode, your SCSI host is never the Controller, as it is considered a GPIB device. It only plays the following two roles:

- Talker–to send data to the GPIB host
- Listener–to receive data from the GPIB host

The Controller-In-Charge and System Controller

Although there can be multiple Controllers on the GPIB, only one Controller at a time is active or Controller-In-Charge (CIC). Active control can be passed from the current CIC to an idle Controller. Only one device

on the bus, the System Controller, can make itself the CIC. The GPIB interface board is usually the System Controller in S mode and is never the System Controller in G mode.

GPIB Signals and Lines

The interface system consists of 16 signal lines and 8 ground return or shield drain lines.

The 16 signal lines are divided into the following three groups.

- Eight data lines
- Three handshake lines
- Five interface management lines

Data Lines

The eight data lines, DIO1* through DIO8*, carry both data and command messages. All commands and most data use the 7-bit ASCII or ISO code set, in which case the eighth bit, DIO8*, is unused or used for parity.

Handshake Lines

Three lines asynchronously control the transfer of message bytes among devices. The process is called a three-wire interlocked handshake, and it guarantees that message bytes on the data lines are sent and received without transmission error.

NRFD* (not ready for data)

NRFD* indicates when a device is ready or not ready to receive a message byte. The line is driven by all devices when receiving commands and by Listeners when receiving data messages.

NDAC* (not data accepted)

NDAC* indicates when a device has or has not accepted a message byte. The line is driven by all devices when receiving commands and by Listeners when receiving data messages.

DAV* (data valid)

DAV* tells when the signals on the data lines are stable (valid) and can be accepted safely by devices. The Controller drives DAV* when sending commands and the Talker drives it when sending data messages.

Interface Management Lines

Five lines are used to manage the flow of information across the interface.

ATN* (attention)

The Controller drives ATN* true when it uses the data lines to send commands and false when it allows a Talker to send data messages.

IFC* (interface clear)

The System Controller drives the IFC* line to initialize the bus and become Controller-In-Charge.

REN* (remote enable)

The System Controller drives the REN* line, which is used to place devices in remote or local program mode.

SRQ* (service request)

Any device can drive the SRQ* line to asynchronously request service from the Controller.

EOI* (end or identify)

The EOI* line has two purposes. The Talker uses the EOI* line to mark the end of a message string. The Controller uses the EOI* line to tell devices to identify their response in a parallel poll.

Physical and Electrical Characteristics

Devices are usually connected with a cable assembly consisting of a shielded 24 conductor cable with both a plug and receptacle connector at each end. This design allows devices to be linked in either a linear or a star configuration, or a combination of the two. See Figures C-1, C-2, and C-3.

The standard connector is the Amphenol or Cinch Series 57 *Microribbon* or *Amp Champ* type. An adapter cable using a non-standard cable and/or connector is used for special interconnection applications.

The GPIB uses negative logic with standard TTL logic levels. When DAV* is true, for example, it is a TTL low level ($\leq$ 0.8 V), and when DAV* is false, it is a TTL high level ($\geq$ 2.0 V).

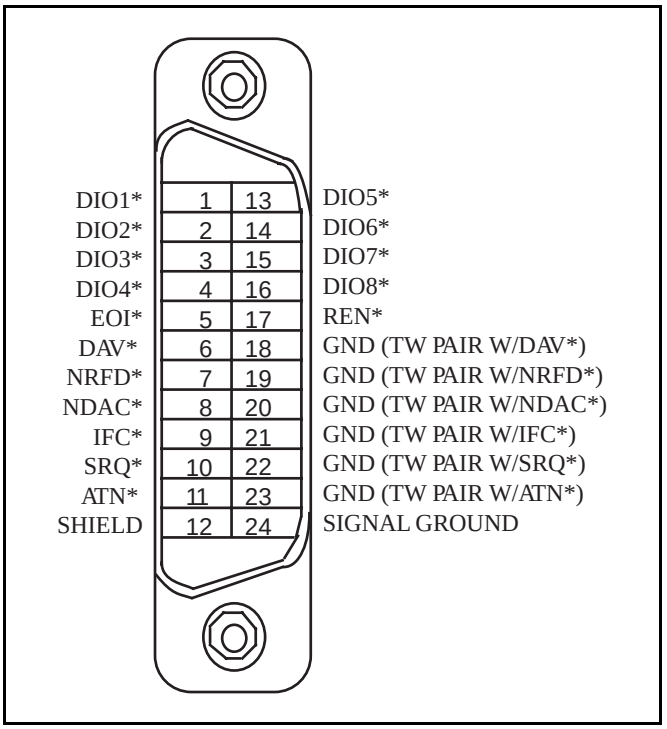
DIO1* 1 13 DIO5*
DIO2* 2 14 DIO6*
DIO3* 3 15 DIO7*
DIO4* 4 16 DIO8*
EOI* 5 17 REN*
DAV* 6 18 GND (TW PAIR W/DAV*)
NRFD* 7 19 GND (TW PAIR W/NRFD*)
NDAC* 8 20 GND (TW PAIR W/NDAC*)
IFC* 9 21 GND (TW PAIR W/IFC*)
SRQ* 10 22 GND (TW PAIR W/SRQ*)
ATN* 11 23 GND (TW PAIR W/ATN*)
SHIELD 12 24 SIGNAL GROUND

Figure C-1. The GPIB Connector and Signal Assignments

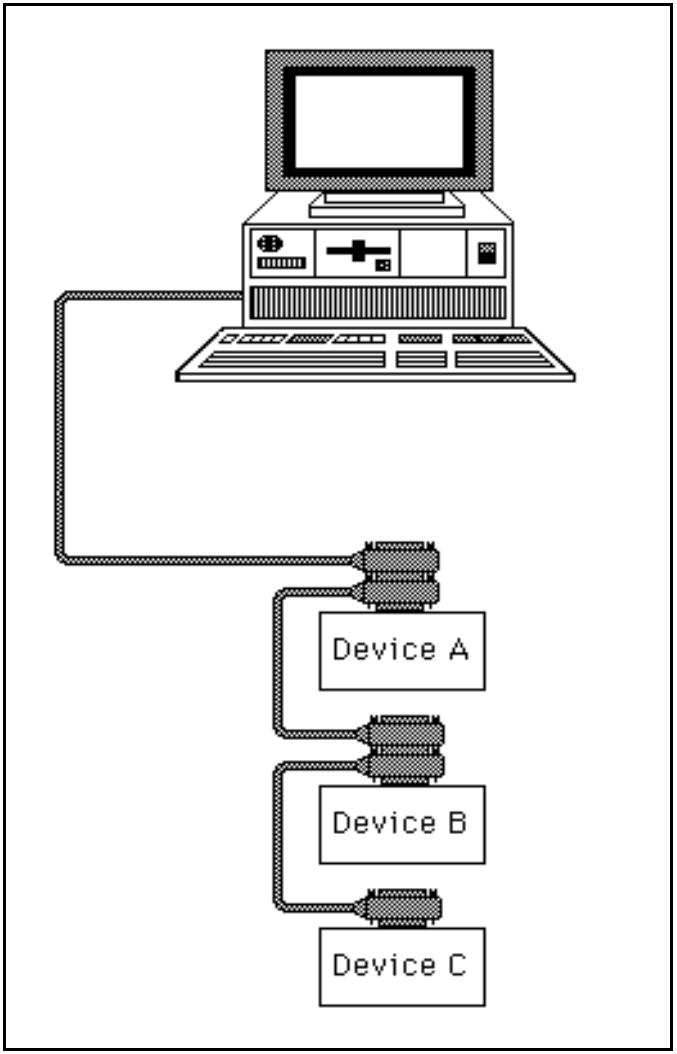

Figure C-2. Linear Configuration

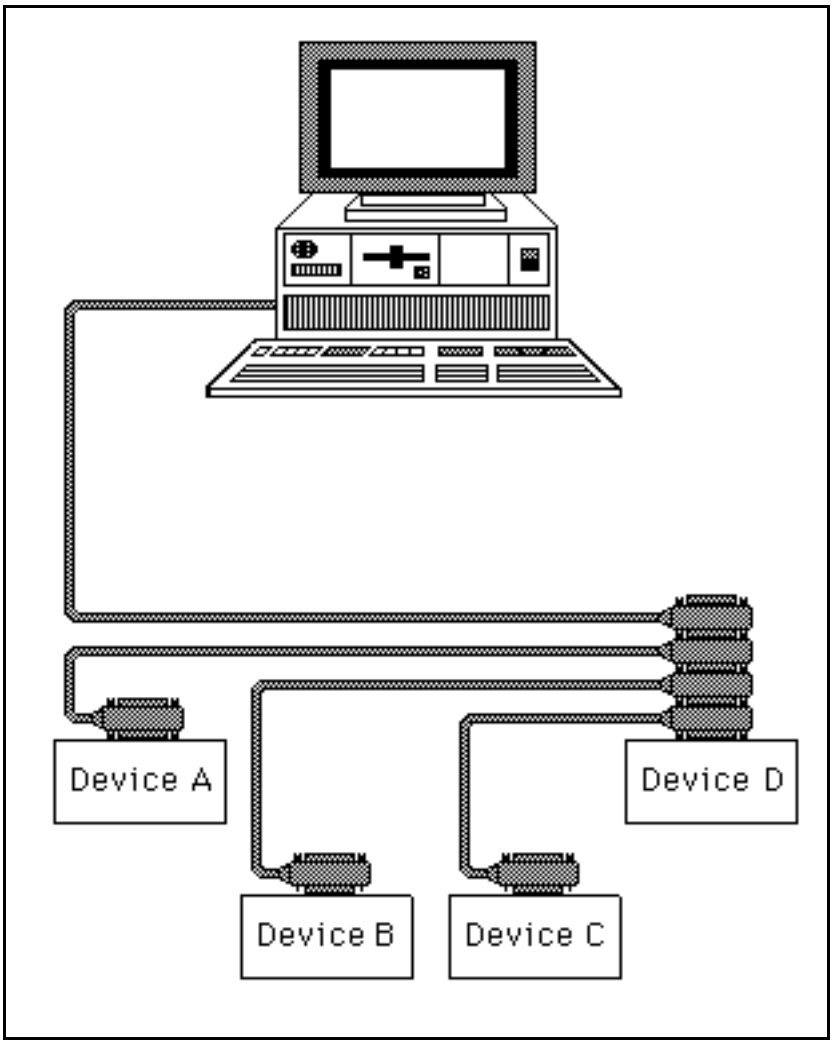

Figure C-3. Star Configuration

Configuration Requirements

To achieve the high data transfer rate that the GPIB was designed for, the physical distance between devices and the number of devices on the bus are limited.

The following restrictions are typical.

- A maximum separation of 4 m between any two devices and an average separation of 2 m over the entire bus.
- A maximum total cable length of 20 m.
- No more than 15 devices connected to each bus, with at least two-thirds powered on.

Bus extenders are available from National Instruments and other manufacturers for use when these limits must be exceeded.

Related Documentation

For more information on topics covered in this section, consult *IEEE Standard Digital Interface for Programmable Instrumentation*, ANSI/IEEE Standard 488.1-1987.

Appendix D
Operation of the SCSI

This appendix describes the operation of the SCSI.

The Small Computer Systems Interface (SCSI) is a specification of mechanical, electrical and functional requirements for a small computer input/output bus. It also contains command sets for communicating with peripheral devices such as hard disks, tape drives, optical disks, printers, and processor devices. SCSI is a local I/O bus that can be operated at data rates of 4+ Mbytes/sec, depending on circuit implementation choices.

History of the SCSI

What is known today as the SCSI, started as a disk interface developed by Shugart Associates that was called SASI for Shugart Associates System Interface. The purpose of this interface was to provide a standardized interface for their Winchester disk drives on microcomputer systems with typically one host and one drive. Many manufacturers designed their disk drives and controller boards to work with SASI, so it quickly became an industry standard. In 1982, The American National Standards Institute (ANSI) created a committee to develop a formal document that would define the SASI based standard. After extensive input and review, the committee concluded that the power of SASI was inadequate and needed enhancements. The resulting interface was the SCSI, which ANSI approved as a standard in 1986.

Operation of the SCSI

All operations done with the SCSI occur only between two devices at a time. When two SCSI devices are using the SCSI, one acts as the *Initiator* and the other as the *Target*. The Initiator is responsible for commanding the Target to perform an operation. After receiving and accepting the command, the Target is responsible for controlling all the information transfer phases. Within physical constraints, the SCSI can have multiple Initiators and Targets on the bus at the same time.

The SCSI uses the following 10 phases to differentiate the type of activity that is occurring at any given time:

- The Bus Free phase
- The Arbitration phase
- The Selection/Reselection phases
- The Command phase
- The Data In/Data Out phases
- The Status phase
- The Message In/Message Out phases

The following description details what each phase handles on the SCSI.

Bus Free This phase is active when the SCSI BSY* signal is not active. This indicates that no SCSI devices are actively using the SCSI bus and that the bus is available for subsequent users.

Arbitration In this phase, one SCSI device can gain control of the SCSI bus so that it can assume the role of an Initiator or Target. This phase is optional. If it is not implemented, there can be only one Initiator. This phase must be implemented in systems that allow for Reselection.

Selection/ Reselection The difference between the Selection and Reselection phases involves the state of the SCSI I/O* signal.

Selection This phase is used by an Initiator to select a Target for the purpose of initiating some Target function. The I/O* signal is not active during this phase.

Reselection This phase is optional and allows a Target to reconnect to an Initiator for the purpose of continuing some operation that was previously started by the Initiator but was

suspended by the Target. The I/O* signal is active during this phase to differentiate it from the Selection phase.

The inclusion of the Reselection phase allows a Target to disconnect from the SCSI bus to perform a time-consuming task relative to the last received command. For example, a SCSI disk drive may disconnect from the SCSI after determining that a physical head seek will be required to process the command. The Target would then disconnect from the SCSI, at which point an Initiator could gain control of the SCSI to process its command or a Target could gain control of the SCSI to finish a previous command if it has disconnected. When the Target disk drive finishes its head seek, it reconnects to the SCSI to finish the command.

The remaining phases are the information transfer phases. During the information transfer phases, the C/D*, I/O*, and MSG* SCSI signals are used to distinguish the type of data being sent along the SCSI. The Target is responsible for driving these signals and, therefore, controls all changes from one phase to another.

Additionally, the Target controls the direction of the information transfer by means of the I/O* signal. If the signal is active, the direction of the information transfer is *from* the Target *to* the Initiator. If the signal is not asserted, the direction of the information transfer is *from* the Initiator *to* the Target.

The SCSI signals REQ* and ACK* form an interlocked handshake between the Initiator and Target during the information transfer phases. ACK* is asserted by the Initiator in response to the assertion of REQ* by the Target. Similarly, ACK* is unasserted after REQ* becomes inactive.

Command — In this phase, the Target requests command information from the Initiator. The Target asserts the C/D* signal and negates the I/O* and MSG* signals during the REQ*/ACK* handshakes for this phase.

Data In/
Data Out — This phase is comprised of two component phases depending on the SCSI I/O* signal.

- **Data In** — In this phase, the Target requests that data be sent *from* the Target *to* the Initiator. The Target asserts the I/O* signal and negates the C/D* and MSG* signals during the REQ*/ACK* handshakes for this phase.
- **Data Out** — In this phase, the Target requests that data be sent *from* the Initiator *to* the Target. The Target negates the I/O*, C/D*, and MSG* signals during the REQ*/ACK* handshakes for this phase.

Status — In this phase, the Target requests that status information be sent *from* the Target *to* the Initiator. The Target asserts the C/D* and I/O* signals and negates the MSG* signal during the REQ*/ACK* handshakes for this phase.

Message In/
Message Out — This phase is comprised of two component phases depending on the SCSI I/O* signal.

- **Message In** — In this phase, the Target requests that messages be sent *from* the Target *to* the Initiator. The Target asserts the C/D*, I/O*, and MSG* signals during the REQ*/ACK* handshakes for this phase.
- **Message Out** — In this phase, the Target requests that messages be sent *from* the Initiator *to* the Target. The Target may invoke this phase at its convenience in response to the ATTENTION condition created by the Initiator's assertion of the SCSI ATN* signal. The Target asserts the C/D* and MSG* signals and negates the I/O* signal during the REQ*/ACK* handshakes for this phase. The Target handshakes bytes in this phase until the Initiator negates the ATN* signal.

Communication on the SCSI

The command definitions in the SCSI specification assume a data structure appearing at the interface as a contiguous set of logical blocks of a fixed or explicitly defined data length. The SCSI device maps the physical characteristics of itself to one of several logical structures defined by the type of device. For example, a hard disk drive might be configured as having its media separated into blocks of a specific size with 512 bytes per block being common.

SCSI devices process the specific commands according to how their device operates. Therefore, the Initiator does not need to keep track of how information is stored on each individual Target, it must know only about the commands the Target accepts. After the Initiator commands the Target, the Target processes the command in the way required for its hardware. In this way, SCSI devices can be attached to many different SCSI systems and the different Initiators only need to know whether the device recognizes the command, not how the device processes the command.

Upon command completion, the Target always returns a single status byte to the Initiator during the Status phase. A status code, CHECK CONDITION, indicates that something did not go as expected with the command and that there is additional information available, possibly indicating what went wrong with the previous command. To receive this additional information, most devices implement a `request sense` command to retrieve this additional information.

Commands are issued to SCSI Targets during the Command Phase in the form of a Command Descriptor Block. This is usually a 6-, 10-, or 12-byte block containing information about the command that the Target is to execute, as well as any additional information the Target may need to execute the requested command. The 6-, 10-, and 12-byte lengths are currently those imposed by the SCSI specification, although the specification allows vendors to create their own device types with their own Command Descriptor Block format.

Each Target on the SCSI can support up to eight logical units. For example, a disk controller card with three physical disks attached can be viewed as one Target with three logical units. For the Initiator to direct to which logical unit the command pertains, many of the Command Descriptor Blocks contain a field to specify the logical unit.

The SCSI also has a bidirectional message system. The COMMAND COMPLETE message is required to be implemented and is usually the message byte that Targets issue after the Status phase when ending the processing of a command. This message indicates that the Target has finished all the processing it will attempt to do on the last issued command. This message is sent even when an error occurs, the status byte is used to indicate that there might be a problem.

SCSI devices indicate their ability to accommodate more than the COMMAND COMPLETE message by asserting (Initiators) or responding (Targets) to the SCSI ATN* signal. The Initiator indicates its ability in the Selection phase by asserting ATN* prior to the SCSI Selection phase. The Target indicates its ability to accommodate more messages by responding to the ATN* condition with the Message Out phase after going through the Selection phase.

The first message sent by the Initiator after the Selection phase should be the IDENTIFY message, which could indicate characteristics about the command to process. The IDENTIFY message is used to indicate that the Initiator can support disconnection/reconnection by processing the Reselection phase, as well as prescribing a Logical Unit Number (LUN) within a Target that should process the command. This LUN supersedes the LUN that may be sent in the Command Descriptor Block during the Command phase.

SCSI Signals

There are two types of signal assignments for the SCSI–either single-ended or differential signal assignments. Because the GPIB-SCSI-A uses only the single-ended signal assignments, the following paragraphs only discuss single-ended signal assignments.

A SCSI single-ended bus consists of 18 signal lines, a line for terminator resistor power, with the remaining lines assigned to ground. The 18 signal lines are divided into two groups:

- Nine data bus signal lines, eight data bits and one parity bit
- Nine control signals

Figure D-1 shows the arrangement of these signals on a standard 50-pin SCSI connector. This is the SCSI connector used on the GPIB-SCSI-A.

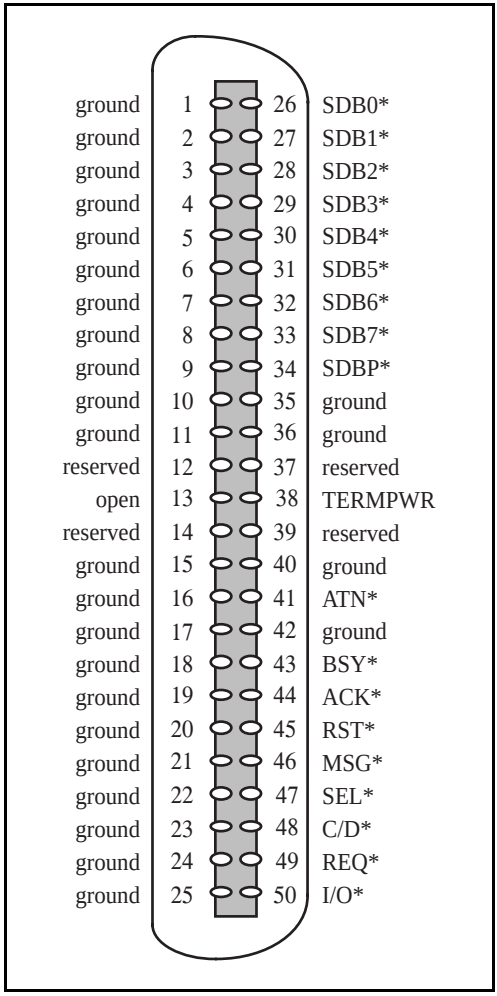
ground 1 26 SDB0*
ground 2 27 SDB1*
ground 3 28 SDB2*
ground 4 29 SDB3*
ground 5 30 SDB4*
ground 6 31 SDB5*
ground 7 32 SDB6*
ground 8 33 SDB7*
ground 9 34 SDBP*
ground 10 35 ground
ground 11 36 ground
reserved 12 37 reserved
open 13 38 TERMPWR
reserved 14 39 reserved
ground 15 40 ground
ground 16 41 ATN*
ground 17 42 ground
ground 18 43 BSY*
ground 19 44 ACK*
ground 20 45 RST*
ground 21 46 MSG*
ground 22 47 SEL*
ground 23 48 C/D*
ground 24 49 REQ*
ground 25 50 I/O*

Figure D-1. Standard 50-Pin SCSI Connector

Data Bus Signals

The nine data bus signals, SDB7* through SDB0* and SDBP*, are used to carry data during the information transfer phases. SDBP* is a SCSI data bus parity and represents odd parity. This means that the number of active signals on the data bus, including the parity bit, is odd. SDB7* through SDB0* are also used in the Selection/Reselection phase to indicate the SCSI ID of the device to select. Table D-1 contains the data bus signals and what they represent during the Arbitration and Selection/Reselection phases.

Note: The SDBP* is not valid during Arbitration, but is valid and represents odd parity during the Selection/Reselection phases.

Table D-1. Data Bus Signals

Signal	Meaning
SDB7*	SCSI ID 7
SDB6*	SCSI ID 6
SDB5*	SCSI ID 5
SDB4*	SCSI ID 4
SDB3*	SCSI ID 3
SDB2*	SCSI ID 2
SDB1*	SCSI ID 1
SDB0*	SCSI ID 0

A SCSI ID of 7 is the highest priority device, a SCSI ID of 0 is the lowest priority device. During Arbitration, if two devices are arbitrating for the SCSI at the same time, the device with the highest priority wins Arbitration.

Control Signals

The nine control signals are RST*, ATN*, BSY*, SEL*, ACK*, REQ*, MSG*, C/D*, and I/O*.

Handshake Lines

REQ* and ACK* form the handshake signals, which asynchronously control the transfer of information bytes between the Initiator and Target. The process is called a four-cycle interlock handshake and it guarantees that the information bytes on the data lines are sent and received without a transmission error. ACK* is asserted by the Initiator in response to the assertion of REQ* by the Target. Similarly, ACK* is unasserted after REQ* becomes inactive.

Phase Control Lines

MSG*, C/D*, and I/O* form the phase control signals, which the Target uses to put the SCSI bus into specific information transfer phases. When asserted, MSG* indicates a Message phase. When C/D* is asserted, it indicates Control (Command or Status) information is on the SCSI data bus. Data is specified when C/D* is unasserted. Finally, I/O* indicates the direction of information transfer. When I/O* is asserted, the direction of transfer is *to* the Initiator. When I/O* is unasserted, the direction of transfer is *from* the Initiator. I/O* is also asserted by the Target during the Reselection phase to distinguish it from the Selection phase.

Miscellaneous Control Lines

The remainder of the control signals are used for specific tasks and indications. RST*, when active for 25 µsec, indicates the SCSI RESET condition. The response to the RESET condition is device specific with some limitations imposed by the SCSI specification.

ATN* is asserted by the Initiator to send a message to the Target. The assertion of ATN* creates the SCSI ATTENTION condition. The Target *may* respond to the ATN* signal by changing into the Message Out phase at its convenience.

BSY* indicates whether or not the SCSI bus is currently being used by another Initiator-Target pair. If the BSY* signal is asserted, the SCSI is in use and potential users must wait to use the SCSI. If BSY* is unasserted, the SCSI is in the Bus Free phase and can be used.

The SEL* signal is used along with the proper data bus bit to allow the Initiator to select the desired Target for an operation during the Selection phase. This signal is also used by the Target when attempting to reconnect with an Initiator during a Reselection attempt.

The TERMPWR Pin

The SCSI bus uses Open-Collector logic, and termination resistors are required to bring the SCSI bus signals up to their correct inactive levels of approximately 3 V. The SCSI uses a daisy-chain configuration and only the last device in the chain must be terminated. However, if the SCSI system has multiple devices, or has more than approximately 3 ft of total cable length, two sets of termination resistors may be required–one set at both ends of the SCSI configuration. If a device with termination resistors is attached to the SCSI bus and the termination resistors are not given power, the unpowered resistors can tie up the SCSI bus and not allow any activity.

Power for these resistors can be received in one of two ways–either the SCSI device provides power for the resistors (not the best solution because this requires that the device be powered on for the terminating resistors to have power) or the device can use the TERMPWR pin on the SCSI bus to power the resistors. If any device on the SCSI provides TERMPWR, the terminating resistors receiving power from the TERMPWR signal have enough power to work correctly and the SCSI bus is not held inactive. The GPIB-SCSI-A provides and uses TERMPWR when powered on and uses TERMPWR provided from another source on the GPIB-SCSI-A if powered off.

Physical and Electrical Characteristics

Devices on a SCSI bus are connected in a daisy-chain configuration as shown in Figure D-2.

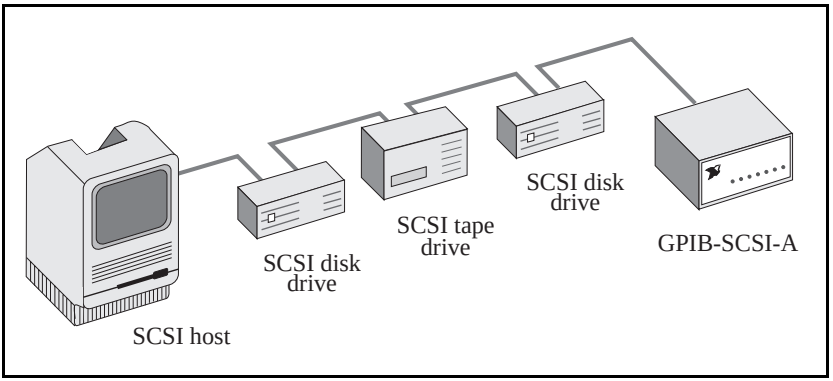

Figure D-2. Daisy-Chain Configuration of the SCSI Bus

The SCSI specification details two types of connectors. The connector for non-shielded cabling, which is normally used for in-cabinet applications, is a 50-conductor ribbon cable type connector consisting of two rows of 25 female contacts. The second type of cabling is the shielded cable. This 50-conductor connector consists of two rows of ribbon contacts.

Configuration Restrictions

To achieve the high data transfer rate that the SCSI is designed for, there are limitations placed on SCSI bus configurations. The SCSI bus can have a maximum of eight devices connected in a daisy chained configuration and the total cable length in a SCSI system cannot exceed 6.0 m.

The last device on the SCSI must have terminating resistors, while all other devices must not have terminating resistors. The only exception to this occurs when the total length of the SCSI system exceeds approximately 3 ft or there are multiple devices attached to the SCSI. In this case, two sets of termination resistors may be required–one set at both ends of the SCSI configuration.

Appendix E
Parallel Polling

This appendix explains the use and operation of parallel polls.

By using parallel polls a GPIB Controller can obtain information from several devices on the GPIB in one operation. The controller polls configured devices and reads back a single response byte that contains one bit of information from each device. From this information, the controller can determine which devices need service.

Operation

A parallel poll can be conducted by the GPIB Controller at any time. To execute the poll, the controller sends the IDY (identify) message on the bus. A device which is configured for parallel polls responds at this time by driving an assigned data line either TRUE or FALSE depending on the value of its individual status (ist) bit. When a parallel poll is conducted, the device determines the value of its ist bit and drives the line to the appropriate value. Whether this line is TRUE or FALSE depends on how the device is configured for the poll.

The circumstances under which a device sets its ist bit are specific to that device. For example, a device might always set its ist bit to 1 when it is busy and 0 when it is free, or vice versa. Consult your device documentation for this information.

There are two steps to conducting a parallel poll–the configuration step, which sets up the devices to participate in the poll, and the poll itself, which reads the data lines and reports the result. The following paragraphs describe these two steps.

Configuration

There are two methods by which a device can be configured to respond to parallel polls. Only one of these two methods may be used by a device. One method is for the device to configure itself. This is referred to in the IEEE 488 specification as Parallel Poll (PP) interface function subset PP2. It is also referred to as local configuration. The other method is for the device to allow itself to be configured by an external controller. This is referred to in the IEEE 488 specification as PP subset PP1. It is also referred to as remote configuration.

In S mode, it is possible to choose which configuration method to use by setting or clearing the PP2 bit of the config function. When the PP2 bit is cleared, the GPIB-SCSI-A uses PP subset PP1. This causes the GPIB-SCSI-A to accept only those configurations that come over the GPIB from an external controller. When the PP2 bit is set, the GPIB-SCSI-A uses PP subset PP2. This causes the GPIB-SCSI-A to allow local configurations, and to ignore configurations that come over the GPIB from an external controller.

In G mode, PP subset PP1 is the only allowable method for parallel poll configurations. Thus, the GPIB controller in your system must configure the GPIB-SCSI-A in order for it to respond to parallel polls.

Parallel Poll configurations are accomplished by using Parallel Poll Enable (PPE) messages and Parallel Poll Disable (PPD) messages. There are 16 possible PPE messages–hex 60 through hex 6F. There are also 16 possible PPD messages–hex 70 through hex 7F. The bits in the PPE and PPD messages have the following meaning:

			U	S	DIO lines 1 through 8		
0	1	1	X	X	X	X	X

Table E-1 contains a list of the parallel poll message bits and a description of each bit.

Table E-1. Parallel Poll Message Bits

Bit	Description
U	If 0 (hex 6X), parallel poll is enabled. If 1 (hex 7X), parallel poll is disabled.
S	If the ist (individual status) bit of the device matches the S bit, the device will set the appropriate data line. Hex 60 through hex 67, set S to 0; hex 68 through hex 6F, set S to 1.
DIO	The value n in bits 0 through 2 corresponds to one of the DIO lines 1 through 8, where n corresponds to DIO line n+1. Thus, a value of 2 (binary 010) corresponds to DIO line 3.

Because the U bit is set in all of the PPD messages, they all have the same effect. All of the PPD messages disable the device from responding to parallel polls.

Issuing Remote Configurations in S Mode

In S Mode, the ppc function can be used to remotely configure devices for parallel polls. Remote configuration is indicated by setting the Me bit in the Command Descriptor Block to 0. For example, if you want to configure a device at address 5 to respond on DIO line 3 when its ist bit is 1, the Command Descriptor Block should have a 5 for the device address. The Me bit should be set to 0, indicating that you want to remotely configure another device. Additionally, the GPIB-SCSI-A also expects the parallel poll message byte to be in the Command Descriptor Block. This message is formed as described below:

			U	S	DIO lines 1 through 8		
0	1	1	0	1	0	1	0

The value of this byte is hex 6A where:

U = 0	Enable Parallel Poll responses
S = 1	When ist = 1 the device will assert DIO line 3 (which corresponds to 010 in bits 0 through 2) in response to a Parallel Poll.

The ppc function sends the talk address of the GPIB-SCSI-A, unlisten, the listen address of the device, Parallel Poll Configure, then the parallel poll message byte (hex 6A in the above example). The parallel poll message byte can be any valid PPE or PPD message.

In order for the ppc function to have an effect, the device that it is configuring must be using PP subset PP1. If the device is not using PP subset PP1, then it does not allow itself to be configured by an external controller, and will probably ignore the configuration.

Use the ppu function to unconfigure all devices on the GPIB from responding to parallel polls. This function causes the GPIB Parallel Poll Unconfigure (PPU) message to be sent. This message has the same effect as using the ppc function to send PPD messages to every device on the GPIB. Like the ppc function, ppu will only affect devices that are using PP subset PP1.

Issuing Local Configurations in S Mode

In S Mode, the ppc function can also be used to locally configure the GPIB-SCSI-A itself. Local configuration is indicated by setting the Me bit in the Command Descriptor Block to 1. For example, if you want to configure the GPIB-SCSI-A to respond on DIO line 5 when its ist bit is 0, the Me bit should be set to 1, and the parallel poll message should be set to hex 64 (binary 0110 0100).

When configuring the GPIB-SCSI-A itself, the ppc function does not send messages out on the GPIB. Instead, it internally configures itself to respond as indicated by the parallel poll message.

In order for the ppc function to have an effect, the GPIB-SCSI-A must be using PP subset PP2. If the GPIB-SCSI-A is not configured to use PP subset PP2, then it cannot allow itself to be locally configured, and will return an ECAP error. The GPIB-SCSI-A can be configured to use PP subset PP2 with the config function.

The Parallel Poll

In S Mode, after configuring the device, the GPIB-SCSI-A now conducts a parallel poll by calling rpp. In the previous example, where the device was sent a configuration byte of hex 6A, if the ist bit of the device is set, rpp returns a value of hex 04. Here, the third least significant bit is set, corresponding to DIO line 3. (If any other devices responded positively on other lines, those corresponding bits would be set as well.)

Note: More than one device can be configured to respond on the same data line, in which case the bits in the response byte are set by the ORing of all the responses on that line.

In G Mode, the GPIB-SCSI-A sets its ist bit whenever it asserts SRQ*, and clears it whenever it unasserts SRQ*. Refer to the srqen function description in Chapter 7 for the conditions under which the GPIB-SCSI-A asserts SRQ*. If the controller has sent it the Parallel Poll Configure byte hex 6D (binary 0110 1101) and parallel polls it while its ist bit is set, it responds by asserting DIO line 6. If the controller sent it the parallel poll configure byte hex 65 (binary 0110 0101) and parallel polls it while its ist bit is set, it responds by not asserting DIO line 6.

S Mode Example

A system has three line printers, one scanner, and one PC with a SCSI port. The PC uses a GPIB-SCSI-A to communicate on the GPIB. All other devices are GPIB devices. The PC is designated to be the controller, and all other devices recognize this. All of the GPIB devices will set their ist bit to 1 when they are busy and 0 when they are free. Furthermore, all of the GPIB devices use PP subset PP1 (remote configuration by the controller).

The controller configures the scanner (at address 6) to respond positively on DIO line 4 (which sets bit 3 of the response byte) when free by sending the configuration byte 01100011. (The S bit is set to 0, the value of bits 0 through 2 is 3.)

Bit / Byte	7	6	5	4	3	2	1	0
0	CD_H							
1	6					0		
2	0					0	0	
3	0							0
4	63_H							
5	0							

When a parallel poll is conducted, one of two things will happen. If the scanner is free, bit 3 of the response byte will be 1; if it is busy, bit 3 will be 0. When the scanner is free, its ist bit is 0 and because this equals the value of the S bit, the device asserts DIO line 4.

The controller configures all of the line printers to respond positively on DIO line 1 when busy. In this case, the configuration byte for each of them is 01101000 (hex 68). When a parallel poll is conducted, the controller can immediately find out if all line printers are free, because the bit 0 of the parallel poll response will be 0. If any line printer is busy, bit 0 of the parallel poll response will be 1, corresponding to DIO line 1 being asserted. However, what if the controller wants to know if one line printer is free? If the controller reconfigures the line printers to respond positively when free (configuration byte = 011000000), then if any device is free, it will drive the DIO line to 1. Thus, the controller can use S-bit/ist bit correspondence for different types of information.

Appendix F
Customer Communication

For your convenience, this appendix contains forms to help you gather the information necessary to help us solve technical problems you might have as well as a form you can use to comment on the product documentation. Filling out a copy of the *Technical Support Form* before contacting National Instruments helps us help you better and faster.

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Denmark	45 76 26 00	45 76 71 11
Finland	(90) 527 2321	(90) 502 2930
France	(1) 48 14 24 00	(1) 48 14 24 14
Germany	089/741 31 30	089/714 60 35
Italy	02/48301892	02/48301915
Japan	(03) 3788-1921	(03) 3788-1923
Netherlands	03480-33466	03480-30673
Norway	32-848400	32-848600
Spain	(91) 640 0085	(91) 640 0533
Sweden	08-730 49 70	08-730 43 70
Switzerland	056/20 51 51	056/20 51 55
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If you are using any National Instruments hardware or software products related to this problem, include the configuration forms from their user manuals. Include additional pages if necessary.

Name _____

Company _____

Address _____

_____

Fax (___)_____ Phone (___)_____

Computer brand _____

Model _____ Processor _____

Operating system _____

Speed _____MHz RAM _____MB

Display adapter _____

Mouse _____yes _____no

Other adapters installed _____

Hard disk capacity _____MB Brand _____

Instruments used _____

National Instruments hardware product model _____

Revision _____

Configuration _____

(continues)

National Instruments software product _____

Version _____

Configuration _____

The problem is _____

_____

_____

_____

_____

_____

_____

_____

List any error messages _____

_____

_____

_____

_____

_____

_____

_____

The following steps will reproduce the problem _____

_____

_____

_____

_____

_____

_____

GPIB-SCSI-A Hardware and Software Configuration Form

Record the settings and revisions of your hardware and software on the line to the right of each item. Update this form each time you revise your software or hardware configuration, and use this form as a reference for your current configuration.

National Instruments Products

- GPIB-SCSI-A EPROM Revision_____
- Application Programming Language_____
- SW1 Switch Setting_____
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- Termination Resistor Pack Installed (yes or no)_____

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Glossary

Prefix	Meaning	Value
μ-	micro-	10^{-6}
m-	milli-	10^{-3}
k-	kilo-	10^{3}
M-	mega-	10^{6}

°	degrees
%	percent
A	amperes
AC	alternating current
ANSI	American National Standards Institute
C	Celsius
CIC	Controller-In-Charge
DIP	dual inline package
DMA	direct memory access
DRAM	dynamic random-access memory
EOI	end or identify
EOS	end-of-string
ft	feet
GPIB	General Purpose Interface Bus
hex	hexadecimal
Hz	hertz
IEEE	Institute of Electrical and Electronic Engineers
in.	inches
lb	pounds
LED	light-emitting diode
M	megabytes of memory
m	meters
max	maximum
Mbytes	1,000,000 bytes
oz	ounces
RAM	random-access memory
ROM	Read-only memory
SCSI	Small Computer System Interface
sec	seconds

V	volts
VAC	volts alternating current
VDC	volts direct current

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